National Park Service
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Natural Resource Stewardship and Science

Prairie Vegetation Monitoring Protocol for the North Coast and Cascades Network

Natural Resource Report NPS/NCCN/NRR—2012/538

ON THE COVER
Clockwise from top: Landscape at American Camp showing herbaceous, shrub and tree cover types; Field crew monitoring a transect; Close-up of prairie vegetation with *Camassia quamash* (camas) in bloom.
Photograph courtesy of National Park Service.

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June 2012

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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Please cite this publication as:

Rochefort, R. M., M. M. Bivin, J. R. Boetsch, L. Grace, S. Howlin, S. A. Acker, C. C. Thompson, and L. Whiteaker. 2012. Prairie vegetation monitoring protocol for the North Coast and Cascades Network. Natural Resource Report NPS/NCCN/NRR—2012/538. National Park Service, Fort Collins, Colorado.

NPS 963/115055, June 2012

Contents

Contents (continued)

Contents (continued)

Contents (continued)

Figures

Figures (continued)

Page

Tables

Page

Tables (continued)

Page

Standard Operating Procedures

Page

Appendices

Page

Executive Summary

Prairies and Garry oak woodlands were once extensive in the lowlands of Washington and Oregon. Today, it is estimated that less than 3% of these areas still exist and many are severely degraded. The goal of the prairie monitoring project is to detect and describe changes in the extent and quality of prairie (herbaceous) communities in San Juan Island National Historical Park. The extent and distribution of prairies, oak woodlands, and forests are important attributes of the park's cultural landscape. There are four primary objectives addressed in this protocol:

1) Detect change in the extent of physiognomic cover types within American Camp and English Camp.
2) Detect change in the proportion of areas dominated by exotic and native species within American Camp and English Camp.
3) Detect change in the quality of herbaceous cover types within American Camp and English Camp.
4) Detect changes in composition and diversity of herbaceous cover types within American Camp and English Camp.

Prairie monitoring follows a two-stage sampling design; the first stage is designed to detect changes in physiognomic cover classes and the second stage focuses on composition of herbaceous communities. Sampling is conducted along parallel transects drawn at random using a general random tessellation stratified sample (GRTS). Physiognomic cover types and origin of predominant species (i.e. exotic or native) are recorded along transects. Species composition, of herbaceous cover types, is monitored within 1 m^2 quadrats located systematically along transects. Status and trends of cover types are assessed through changes in dominance of native versus exotic species origin of predominant species, species richness, average Coefficient of Conservatism ($\overline{C}$) the floristic quality index (FQI), and changes in species composition. Ecological integrity of cover types is classified as good, caution, or significant concern based on status of the cover types. Trends in cover of predominant species, floristic quality, and extent of cover types are used to describe whether the status of the cover type is stable, improving, or declining.

Acknowledgments

We would like to thank the field crews that conducted the pilot surveys of field methods and offered suggestions for improvement of the methodology. Allen McCoy and Craig Dalby tested the use of aerial photography to detect changes in vegetation cover and USGS funded this portion of the study. Laurie Kurth and Dr. Andrea Woodward worked with us during the initial stages of this project and contributed significantly to the development of goals and cover types.

Introduction

This protocol narrative outlines the rationale, sampling design and methods for monitoring prairie vegetation in the North Coast and Cascades Network (NCCN). The primary mission of the National Park Service (NPS) is to conserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment of present and future generations. In 2000, the NPS Inventory and Monitoring Program (I&M) was established to provide scientifically sound information on natural resources by documenting the current status and long term trends in the composition, structure, and function of park ecosystems and to determine how well current management practices are sustaining those ecosystems (National Park Service 2001, Fancy et al. 2009). The I&M program is organized nationally around 32 monitoring networks including approximately 270 park units. Each network identifies key indicators or "vital signs" to track the overall condition or "health" of park natural resources and to provide early warning of situations that require intervention (Davis 1989, 2005, Fancy et al. 2009). As one of these networks, the NCCN is composed of seven NPS units including two with significant prairies: San Juan Island National Historical Park (SAJH) and Ebey's Landing National Historical Reserve (EBLA) (Figure 1). Although there are no extant prairies in Fort Vancouver National Historic Site (FOVA), they were an important component of the historic landscape.

Since 1997, numerous monitoring workshops and meetings have been conducted in the NCCN to identify key park ecosystem components, core indicators, and to allocate limited funding to the development and implementation of monitoring protocols (Weber et al. 2009). As part of this process, prairie vegetation was identified as one of the park ecosystem components for protocol development (see Appendix A, Administrative Record). This protocol adheres to the structure and content recommendations by Oakley et al. (2003). Methodological details of the protocol are addressed in a set of standard operating procedures (SOPs) found at the end of the document, along with appendices containing additional supporting materials referred to in the narrative.

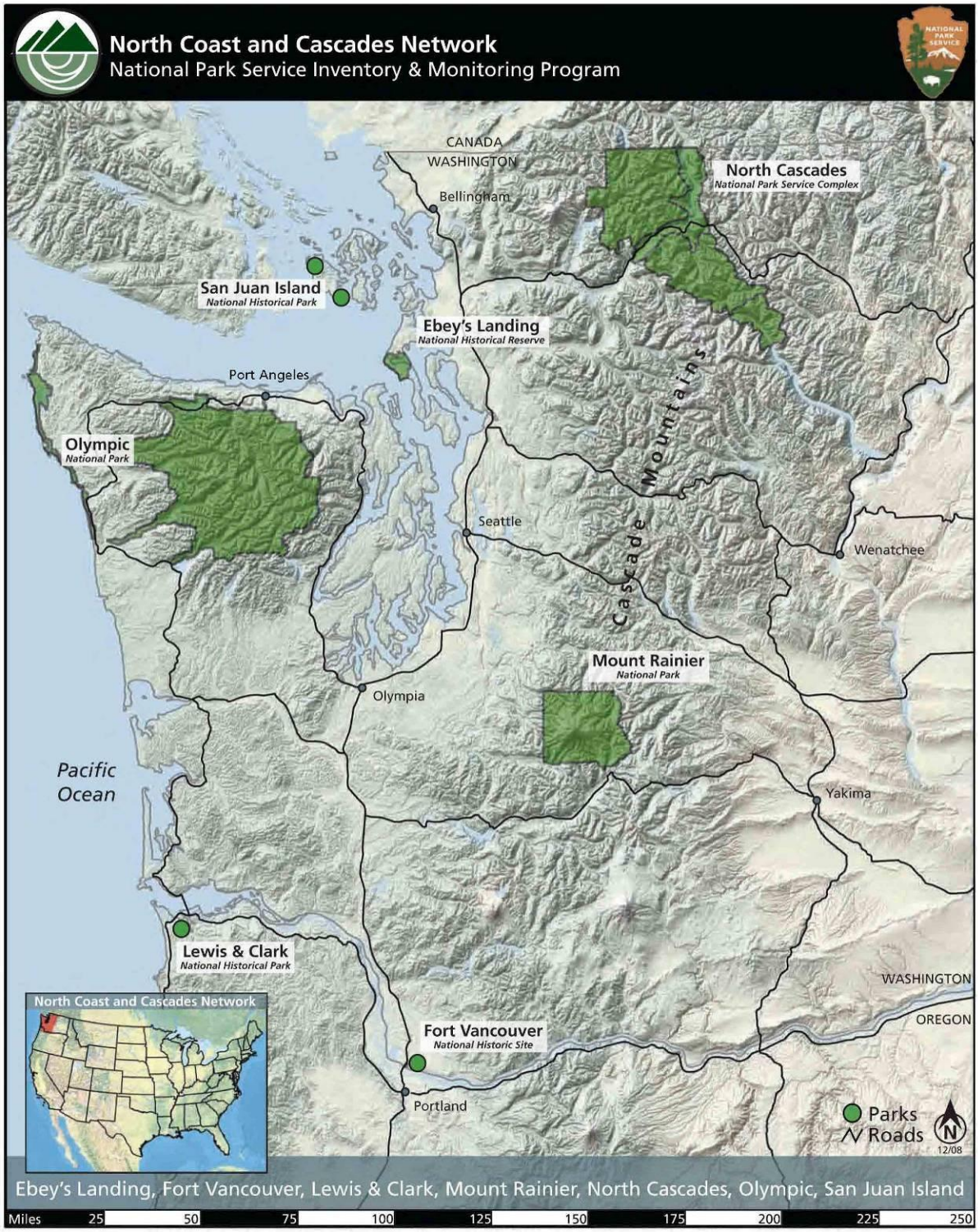


Figure 1. Map illustrating the location of park units within the North Coast and Cascades Network.

1. Background and Objectives

A. Background and History

Prairies and oak woodlands were once extensive in the Puget Lowlands of Washington (Franklin and Dyrness 1988, Dunn and Ewing 1997, Pater et al. 1998, Dunwiddie et al. 2006) (Figure 2). These grass-dominated landscapes developed during the warmer climates of the early Holocene on the gravelly, outwash soils that remained following the last glacial episode, the Vashon stade (Ugolini and Schlicte 1973, Whitlock 1992, Booth 1994, Foster and Shaff 2003, USDA-USDI 2005, Lambert 2006, Sprenger 2008). As cooler and wetter climates returned, many prairies were maintained by periodic burning by Native Americans to remove encroaching trees and shrubs and to encourage important food plants such as camas (*Camassia quamash* and *Camassia leichtlinii*), chocolate lily (*Fritillaria lanceolata*), and Garry oak (*Quercus garryana*) (Kruckeberg 1991, Whitlock 1992, Foster and Shaff 2003, Weiser 2006).

After settlement in the mid 1800s, fire frequency decreased and many prairies and open woodlands were invaded by trees (Agee 1984, 1987, 1993, Peterson and Hammer 2001, Foster and Shaff 2003). Over time, continued agricultural use, grazing, urban development, and invasion by exotic plant species have contributed to the decline of prairie habitats (Chappell et al. 2003). Today, these ecosystems are some of the most endangered in western Washington (Dunn and Ewing 1997, Chappell et al. 2001). Crawford and Hall (1997) estimated that 97% of historic native grasslands have been lost in the Puget lowlands of Washington (Figure 2).

Ebey's Landing National Historical Reserve (EBLA) encompasses approximately 7,820 hectares (ha) on Whidbey Island. Prior to European settlement, prairies and oak woodlands were extremely important to the Skagit Indians for the production of camas (*Camassia quamash*), bracken fern (*Pteridium aquilinum*), and nettles (*Urtica dioca*) despite the fact that prairies only covered about 5% of Whidbey Island (see Figure 3). Later, when the pioneers arrived, they often chose to settle on the prairies rather than make the effort to clear forests for agricultural fields (Weiser 2006, Sheehan 2007). One example of this is Ebey's Prairie which was claimed by Isaac Ebey, in October, 1850 under the Donation Land Claim Act (Sheehan 2007). Today the cultural landscape at Ebey's Landing National Historical Reserve still encompasses some degraded remnants of these important habitats. Currently, two rare plant species still grow in prairie remnants in EBLA: golden paintbrush (*Castilleja levisecta*) and white-top aster (*Sericocarpus rigidus)* (Sheehan 2007). Golden paintbrush was once a common component of native grasslands in Washington, Oregon, and British Columbia. It was federally listed as threatened in 1997 and now exists in 12 populations, 5 of which are within EBLA.

The landscape of San Juan Island National Historical Park encompassed extensive prairies prior to the arrival of Europeans in the 1800s (Agee 1984, USDA-USDI 2005). Recent soil surveys indicate that prairies were present at American Camp and oak woodlands were present at English Camp (USDA-USDI 2005) (Figures 4 and 5). Although anthropogenic activities (i.e. burning by Native Americans) probably maintained the location and integrity of the oak woodlands at Young Hill in English Camp, agricultural use of American Camp initiated the degradation of the prairies. During the historic period of the Hudson Bay Company (1853-1875), Bellevue Farm was established in the area now called American Camp and over 4,000 sheep, cattle, horses, and hogs grazed on much of the area. Historic accounts indicate that a sheep farm that was established by the Hudson Bay Company on the prairie habitat at American Camp early in the

1850's, had the effect of significantly reducing many native prairie grassland plants (Rolph and Agee 1993). Additionally, farming and the introduction of rabbits altered the native prairies by introducing or facilitating the spread of non-native species. For example, creeping bentgrass (*Agrostis stolonifera*) is a wide spread turf grass introduced from Europe for pastures and lawns that is currently found in the lowland prairie areas of American Camp. Creeping bentgrass grows in dense mats, reproduces through stolons and is adapted to high levels of disturbance, such as grazing (Pojar and MacKinnon 1994). The invasion or increase of creeping bentgrass at American Camp likely resulted from early disturbance of the native grasses by both grazing of sheep and livestock (Avery 2004). Non-native species such as bentgrass *(Agrostis sp.)*, velvet grass *(Holcus lanatus)*, Kentucky bluegrass *(Poa pratensis)*, quackgrass *(Elymus repens)* and American vetch (*Vicia americana*), form large monocultures across the grassland (Lambert 2006, Rochefort and Bivin 2010). After the termination of farming at American Camp, shrubs and trees such as snowberry (*Symphoricarpos albus*), the introduced one-seed hawthorn (*Cratageus monogyna*), and Douglas fir (*Pseudostuga menziesii*) have invaded some areas of the prairies (e.g., western edge and north aspects) where soil moisture is adequate. Areas in the center of the prairie have remained as prairies due to environmental conditions such as droughty soils, cool soil temperatures, and persistent winds (USDA-USDI 2005).

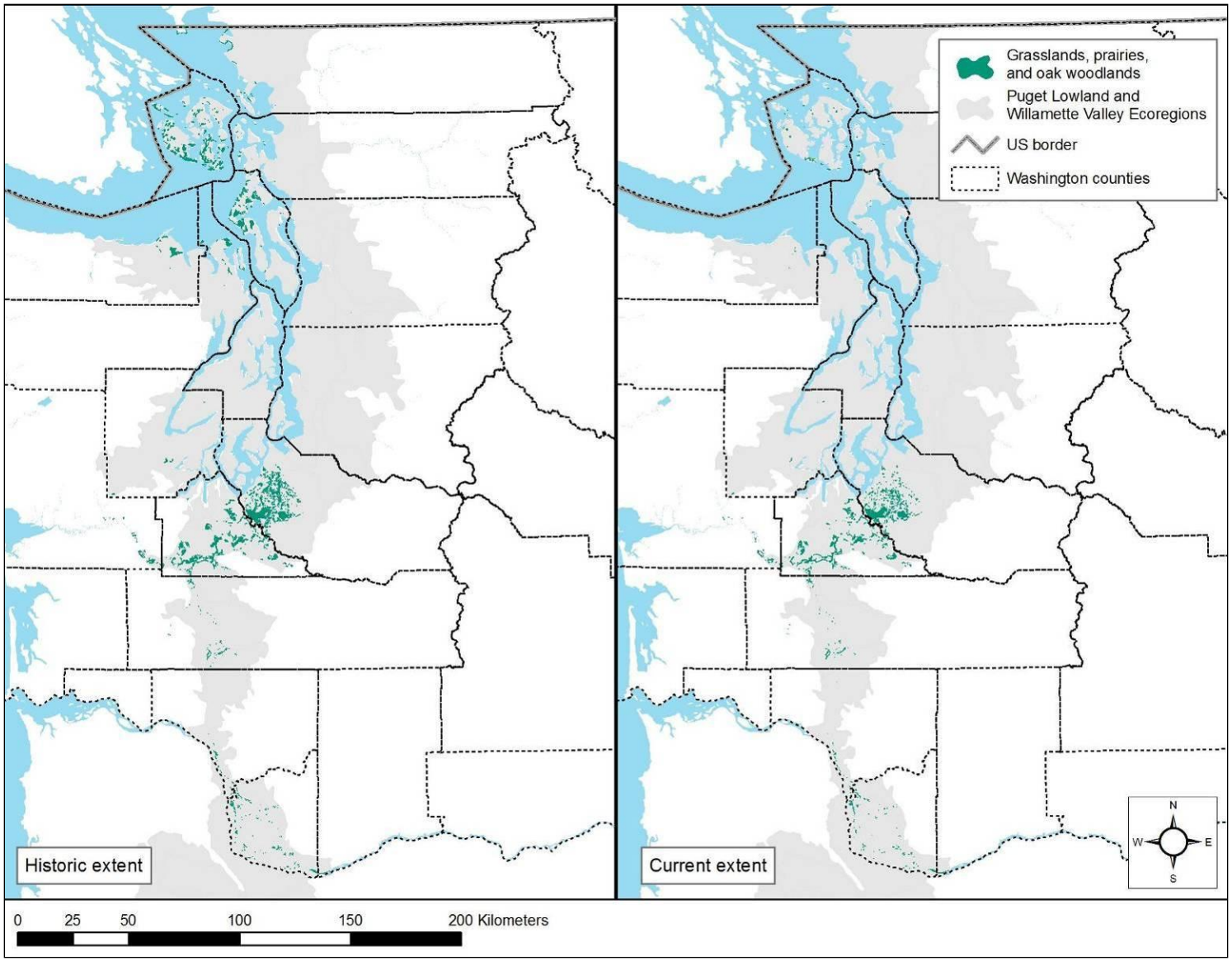


Figure 2. Historic and current distribution of prairies and oak woodlands in the Puget Sound lowlands.

Figure 3. Extent of historic prairies and oak woodlands on Whidbey Island based on soil development (based on Sheehan 2007).

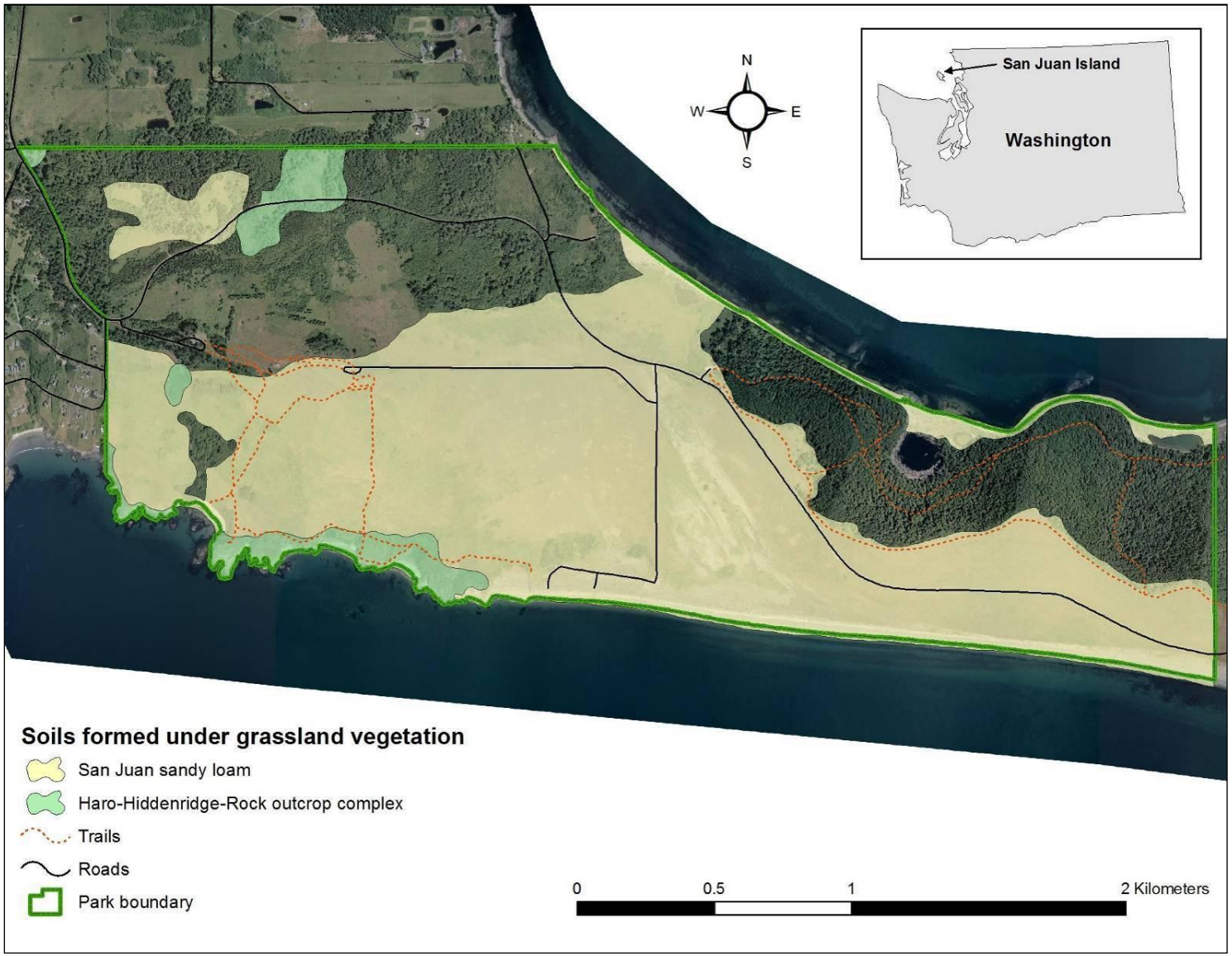


Figure 4. Map illustrating soils that developed under grassland vegetation at American Camp, San Juan Island National Historical Park.

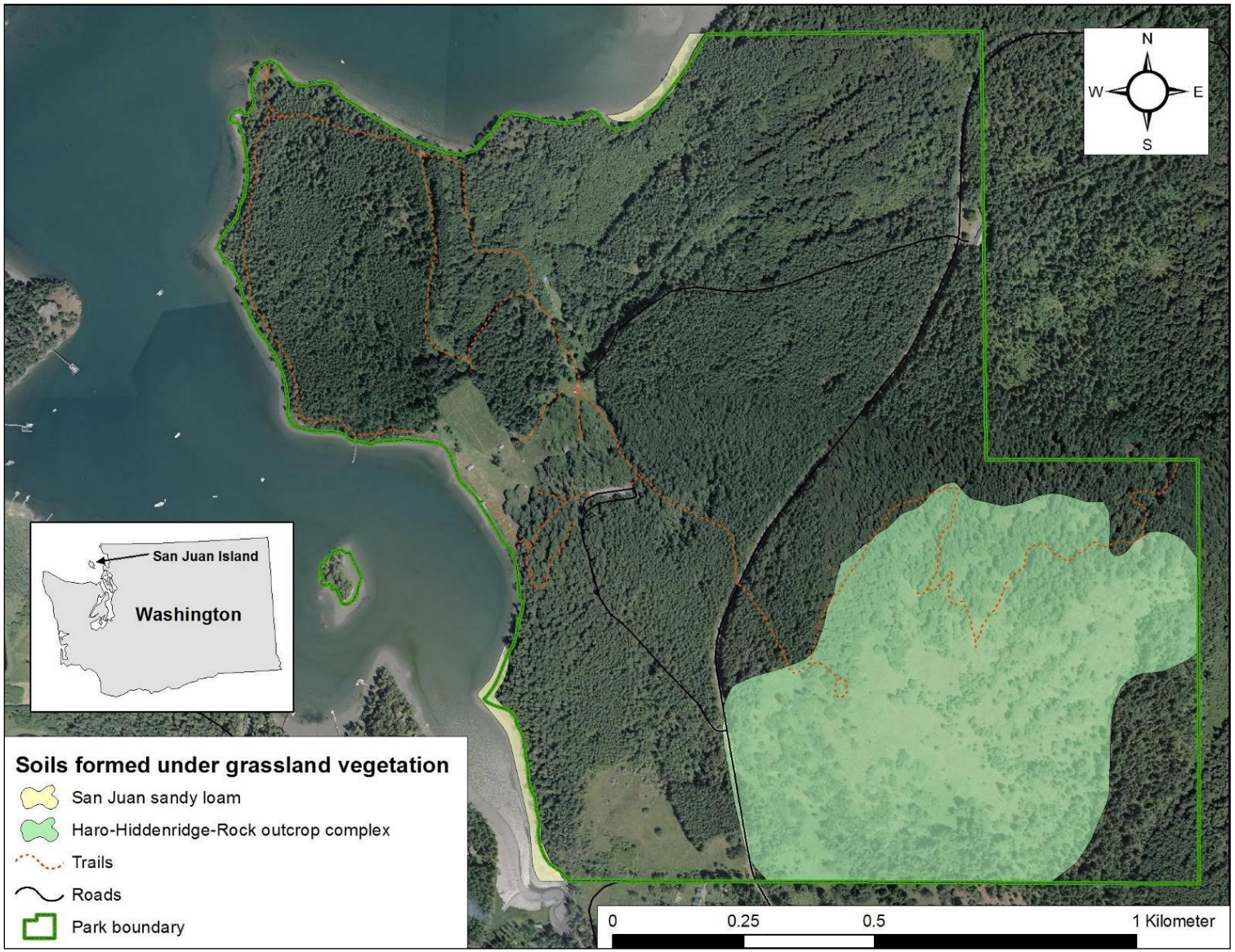


Figure 5. Map illustrating soils that developed under grassland vegetation at English Camp, San Juan Island National Historical Park.

B. Rationale for Monitoring Prairies in the NCCN

Prairies and oak woodlands provide important habitat for many federally or state listed species including Fender's Valley silverspot (*Speyeria zerene bremnerii*, Edwards, federal species of concern), Taylor's checkerspot (*Euphydryas editha taylori* Edwards, federal candidate), Mardon skipper (*Polites mardon* Edwards, federal candidate), the island marble butterfly (*Euchloe ausonides insulanus*), and golden paintbrush (*Castilleja levisecta*, federal threatened). Restoration of native prairies is a priority for state and federal agencies and private conservation partners in western Washington and Oregon (e.g. the North Puget Sound Prairie Working Group http://www.northsoundprairies.org/).

Despite the past alteration of the landscapes at American and English Camp, significant remnants of native prairies and oak woodlands remain. Currently about 281 ha of prairie remain at American Camp and 26 ha at English Camp. Recent surveys documented at least 87 patches of native prairie distributed across the American Camp landscape. These patches have been classified into five prairie communities containing 60 native plant species. These communities are: the *Festuca roemeri* (Roemer's fescue) community, the *Leymus mollis-Holcus lanatus* (dune grass/ velvet grass), *Juncus balticus-Schedonorus pratensis-Juncus effusus* (Baltic rush-meadow fescue-lamp rush), *Lupinus littoralis-Bromus rigidus* (seashore lupine-ripgut brome), *Bromus sitchensis-Bromus hordeaceus-Poa pratensis* (Sitka brome- soft brome-Kentucky bluegrass), and the *Abronia latifolia* (coastal sand verbena) community (Figure 6, Rochefort and Bivin 2010). In addition, the island marble butterfly (*Euchloe ausonides insulanus*) was discovered at American Camp in 1998 after having been presumed to be extinct. This butterfly utilizes three host plants: the native Menzies' pepperweed (*Lepidium virginicum var. menziesii*) and two exotic species: common mustard (*Brassica rapa L. ssp. campestris)* and tall tumble mustard (*Sisymbrium altissimum)* (Lambert 2009**).** Removal of the non-native rabbits and restoration of the American Camp native prairie are goals within the SAJH General Management Plan (National Park Service 2008). Restoration of the oak woodlands is listed as a priority for English Camp (National Park Service 2005, 2008).

During the Vital Signs workshops for SAJH and EBLA monitoring of the extent and condition of prairie habitats was identified as a priority for long-term monitoring. Most of the prairies within EBLA are highly degraded (Sheehan 2007) while patches of prairies and Garry oak woodlands at SAJH still retain dominance by native species (National Park Service 2005, Rochefort and Bivin 2010). During the development of the NCCN Monitoring Program, it was determined that prairie monitoring would focus on the prairies at American Camp of SAJH (Weber et al. 2009). The monitoring protocol presented in this report also includes components for monitoring the oak woodland at English Camp. Currently, the priority for EBLA is to work with the North Puget Sound Prairie Working Group to support prairie restoration.

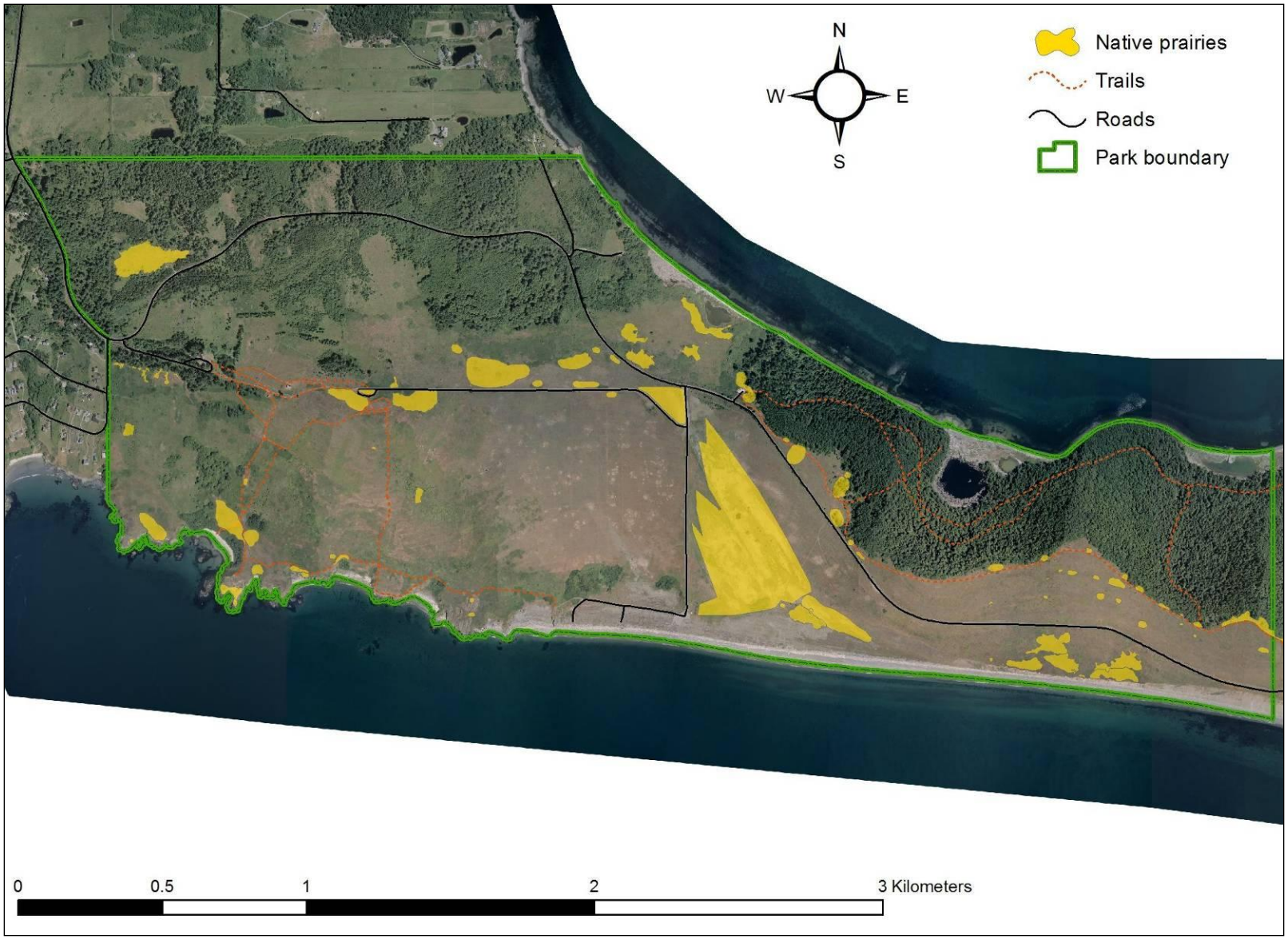


Figure 6. Distribution of native remnants at American Camp, San Juan Island National Historical Park, determined during 2003 field surveys.

C. Measurable Objectives

The goal of the prairie monitoring program is to detect and describe changes in the extent and quality of prairie communities in San Juan Island National Historical Park. The extent and distribution of prairies, oak woodlands, and forests are important to both parks because, along with historic structures, they contribute to the park's cultural landscape (National Park Service 2008). Evaluating the quality of prairies and oak woodlands is an initial step in the development of restoration goals and selection of specific restoration methods. For these reasons, we developed a hierarchy of monitoring questions starting with a broad monitoring objective focused on the geographic extent of prairies and ending with our most detailed question regarding species composition and quality of prairie (herbaceous) communities.

There are four primary objectives addressed in this protocol:

1) Detect change in the extent of physiognomic cover types within American Camp and English Camp.
2) Detect change in the proportion of areas dominated by exotic and native species within American Camp and English Camp.
3) Detect change in the quality of herbaceous cover types within American Camp and English Camp.
4) Detect changes in composition and diversity of herbaceous cover types within American Camp and English Camp.

We characterize the quality of herbaceous communities in two ways: proportion of area dominated by native versus exotic species and Floristic Quality Assessment (Swink and Wilhem 1979). Floristic Quality Assessment (FQA) was proposed by Swink and Wilhelm (1979) as a method to evaluate the floristic integrity (quality) of ecological units. FQA refers to a suite of indices that are calculated using one common variable - the Coefficient of Conservatism (C). Each native species is assigned a C value of 0 to 10 that estimates their: 1) tolerance to disturbance and types of disturbances and 2) their fidelity to natural areas. Weedy species that generally grow in severely disturbed sites are assigned C values of 0 to 3, species that can survive in natural habitats even with significant degradation receive a value of 4-6, and species that have high fidelity to natural habitats with only minor degradation, receive a value of 7-9. Species that are restricted to high quality natural areas are rated with a 10.

The index is based on the principle that patterns of vegetation reflect biotic and abiotic factors, but as the frequency, intensity, and duration of anthropogenic disturbance continues, predictable changes in plant species composition will result (Taft et al. 1997, 2006). Multiple variations of FQA indices have been used throughout the Midwest, Southeast, East, and Great Plains to assess status of prairies and wetlands (Taft et al. 1997, Lopez and Fenessy, 2002, De Keyser et al. 2003, Jog et al. 2006). Currently the Washington Natural Heritage Program has initiated a program to develop Coefficients of Conservatism for use in western Washington. The optimal indices and target values for evaluating ecological integrity for SAJH prairies will be refined during the first five years of the prairie monitoring program.

Linking Monitoring Results with Park Management

Our monitoring design represents a hierarchy of questions based on ecological and management concerns on multiple spatial scales. At each level, we discussed the management application of

specific monitoring parameters and wanted to clearly articulate these applications for park management and the public (Tierney et al. 2009). Benchmarks for the first three objectives have been proposed, but benchmarks for objective 4 will be developed after protocol implementation and a thorough status assessment of herbaceous communities has been completed. Finally, we felt that by structuring our questions by Camp and by the intensity of monitoring effort, this would also assist in developing our funding needs for the protocol (Table 1).

Table 1. Hierarchy of monitoring questions and link to management issue.

Objective	Metric type	Response Variables	Ecological Integrity Rating[1]		
			Good	**Caution**	**Significant Concern**
1. Detect change in the extent of physiognomic cover types	Landscape Structure	Cover Type: forest vs. non-forest[2]	<10% difference between annual estimate of either tree or non-tree cover from baseline	10-30% difference between annual estimate of either tree or non-tree cover from baseline	>30% difference between annual estimate of either tree or non-tree cover from baseline
2. Detect change in the proportion of area dominated by exotic plant species	Vegetation Community Structure	Total Park Cover	≤10% of area is dominated by exotic species	11-30% of area is exotic	>30% of area is exotic
		Tree (forest) Cover	≤10% of area is exotic	11-30% of area is exotic	>30% of area is exotic
		Shrub Cover	≤10% of area is exotic	11-30% of area is exotic	>30% of area is exotic
		Herbaceous Cover	≤10% of area is exotic	11-30% of area is exotic	>30% of area is exotic
3. Detect change in quality of native herbaceous communities	Quality of Native Herbaceous Communities	Exotic Cover	90% of native-dominated areas have ≤10% exotic cover	≤50% of native-dominated areas have >50% exotic cover	>50% of native-dominated areas have >50% exotic cover
		Mean C[3]	≥10	4-10	1-3
		Average Weed Score[4]	≥-1	-1 to -2	< -2
4. Detect change in composition and diversity of herbaceous communities	Species Composition	Native Species Cover Exotic Species Cover Species Diversity Species Richness	All benchmarks will be developed after status surveys are completed.		

[1] Ecological integrity rating reflects the status of the parameter and trend will be used as a modifier to describe whether the condition of the parameter is stable, improving, or declining.

[2] The baseline for this objective is the ratio of forest to nonforest cover that was present during the historic period of significance 1853-1875. The metric for this parameter will be the ratio of soils that developed under forest vs. non- forest vegetation as interpreted by the soils survey (see Figures 4 and 5) as this reflects the cover types that were present during the historic time period.

[3] The mean C will be used in concert with native species richness, FQI, and native species cover. The estimates in the table are preliminary estimates based on pilot data, see Appendix B.

[4] Weed score is based on local ranking that is under development following Bowers and Boutin 2008, see Appendix B.

2. Rationale and Selection of Sampling Frame and Methodology

A. Background

Initial Considerations: Field Based or Remote Sensing Methodology

Our first goal was to determine whether remote sensing or field sampling methods would best meet NCCN prairie monitoring goals. The park owned aerial photography that had been taken in September 1997 (15-cm resolution, 24-bit natural color). Andrea Woodward, USGS, provided funding to obtain current aerial photos and to support a GIS-based analysis of landscape change, which was conducted by Alan McCoy and Craig Dalby of the NPS Pacific West Region GIS group. Aerial photography was flown in June 2007 (15-cm resolution, 24-bit natural color) and analyzed using ArcGIS 9.2 from Environmental Systems Research Institute, Inc. of Redlands, California, and Feature Analyst® 4.1 (an ArcGIS extension) from Visual Learning Systems, Inc of Missoula, Montana (McCoy and Dalby 2009).

Simultaneously, we tested a field-based monitoring method using line-intercept methods at American Camp. First we needed to determine how many transects to sample. We used the GIS layer of native prairie polygons that was developed in the SAJH Inventory (Rochefort and Bivin 2010) and included 87 polygons ranging in size from 0.004 - 15 ha (see Figure 6). We conducted a computer simulation to investigate the statistical power to detect trends in native cover of prairie vegetation under various levels of sampling intensity. Sampling intensity was defined by the number of transects, although total linear distance of transects varied along with the number of transects. The simulation investigated the power to detect trends in the cover of native prairie patches with a 90% probability (acceptable rate of type 1 error of 10%). In this simulation, sampling intensity varied from 10 to 50 transects in increments of five. Start points were jiggled in a random direction by a random number because we were planning to use unmarked transects. For each sampling intensity level, 1000 sets of random transect locations were generated. The effect sizes chosen for the simulation were decreases of 1% and 0.5% of native prairie area per year, resulting in a loss of 3.2 and 1.6 ha, respectively, after ten years. Power was calculated as the percentage of replications that detected a significantly non-zero decreasing trend. Power estimates for the cover parameter, with a 99% probability, increased from 0.91 to 1.0 with a sample size of 35. Based on the results of the simulations and time constraints, we field tested 25 transects in 2008 and 2009.

Results of Pilot Testing: Field Transects or Remote Sensing

McCoy and Dalby (2009) found that Feature Analyst could efficiently compile data on vegetation cover classes such as forest, prairies, bare sites, and developed areas, but it was not a practical method for delineation of prairies that were being invaded by shrubs or trees. The remote sensing work provided a good baseline map of the current distribution of broad cover types and a perspective on the changes in cover that had occurred over the last ten years (Table 2, Figures 7 and 8). In particular, the change detection project highlighted areas in American Camp where trees had re-established following tree removal for farming (after the historic period of 1853-1871), areas which were replanted by the NPS in 1986 (Rolph and Agee 1993), and areas in English Camp where the fire crew had removed shrubs in the Garry oak woodland.

However, this method did not document recent shrub or young tree invasion in historic prairie areas.

Table 2. Land cover summary for American and English Camp as determined using Feature Analyst.

	American Camp		English Camp	
Land Cover Type	**1997 (ha)**	**2007 (ha)**	**1997 (ha)**	**2007 (ha)**
Bare Earth	34.4	34.6	0.5	0.4
Buildings	0.04	0.04	0.08	0.08
Forest	146.3	176.4	173.4	174.2
Managed Grassland	2.1	5.1	2.9	3.4
Prairie	312.1	281.5	26.7	25.9
Roads	6.7	6.8	1.4	1.4
Water	3.6	4.1	0.2	0

Field-based transects did provide the level of detail we were interested in, but we also found it tempting to collect detailed, subjective data that was not repeatable by multiple observers. Initially, we thought we could monitor change in distribution of simple vegetation cover types such as prairies and forests. As we walked the field transects we found ourselves adding categories such as shrubs, dunes, sand flats and by 2008, our simple vegetation cover types had evolved into twenty-six complex classes defined by vegetation, substrate, slope, and condition (e.g. evidence of grazing, origin of vegetation). We realized that we needed to drastically revise our vegetation cover types in order to develop a robust monitoring protocol that would both address our management needs and produce consistent results with multiple observers.

Ultimately, we revised our twenty-six vegetation cover classes to five physiognomic cover classes with modifiers based on origin and condition (listed in Table 4, described in Field Methods). This combination of cover types and modifiers was tested in 2008 and 2009 and produced consistent results with multiple observers. These cover types complemented the categories we had utilized with our remote sensing approach, but added the levels of detail (i.e., recent establishment of shrubs or trees) that we were interested in to provide an early warning of changing cover types.

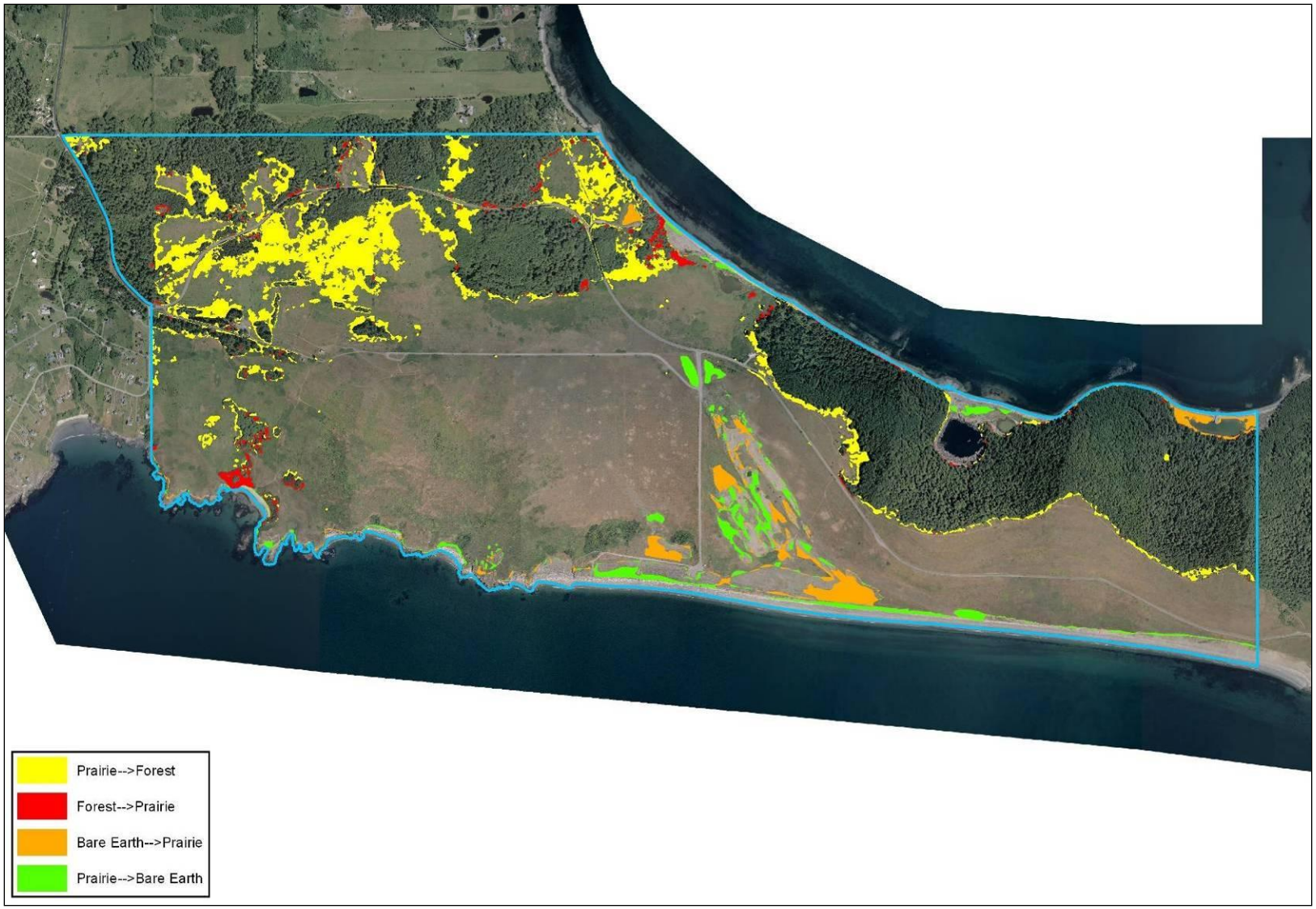


Figure 7. Map illustrating change in vegetation cover between 1997 and 2007 at American Camp, San Juan Island National Historical Park (McCoy and Dalby 2009).

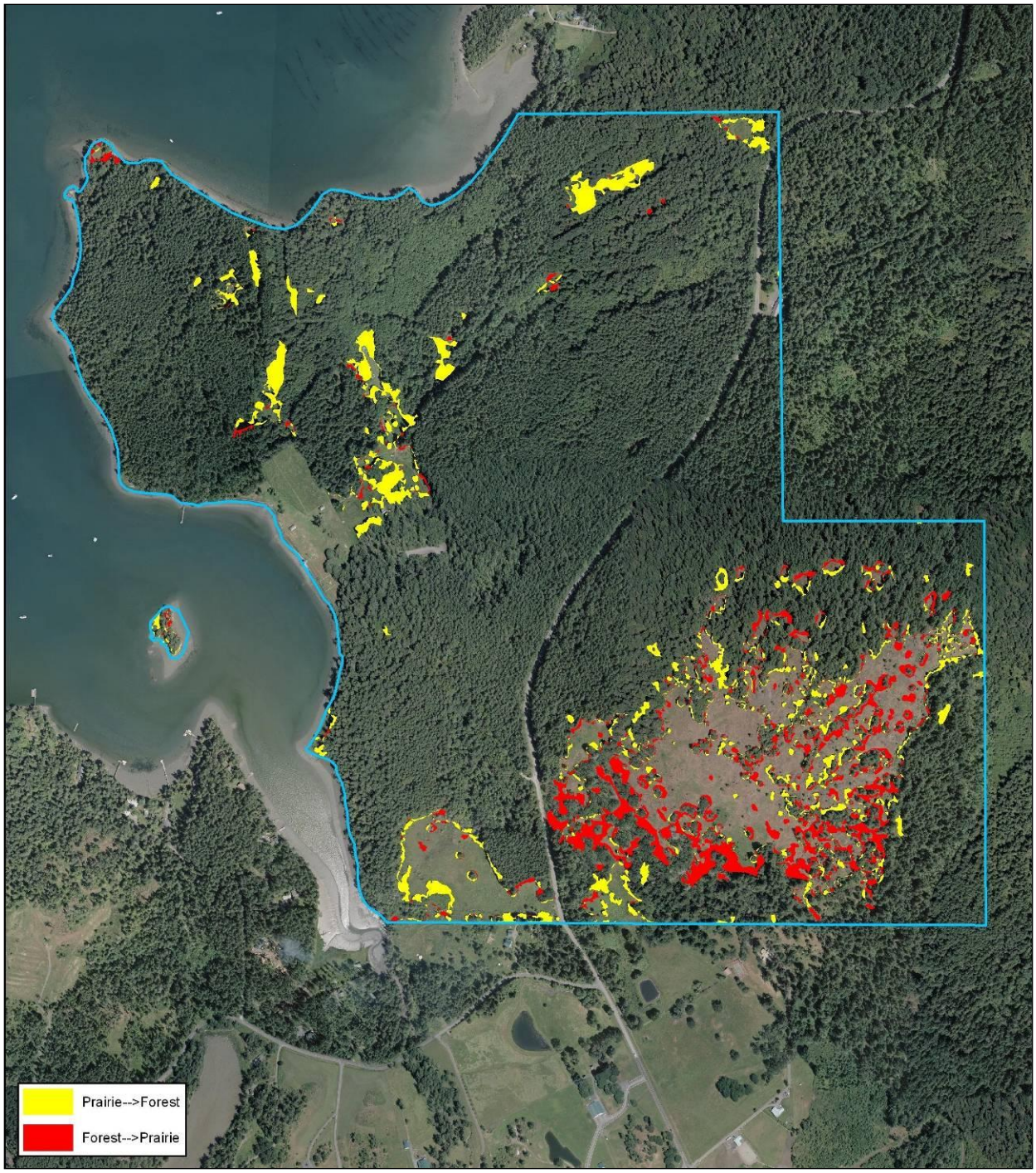


Figure 8. Map illustrating change in vegetation cover between 1997 and 2007 at English Camp, San Juan Island National Historical Park (McCoy and Dalby 2009).

B. Sample Design

Prairie Sample Frame

Monitoring will follow a two-stage sampling plan (Thompson 1992) using parallel transects as the first stage of sampling. At American Camp, our sample population is the entire camp and transects will be oriented north-south (Figure 9). Due to the small and isolated area of oak woodland at English Camp, our sample population will only include the southeast portion of the park near Young Hill; transects will be oriented east-west (Figure 10). A generalized random tessellation stratified (GRTS) sample of transects was selected for stage one (Stevens and Olsen 2004). Sampling within each camp will utilize a split panel design with one panel visited annually and 5 rotating panels visited every five years. There are 45 transects in this sample for American Camp and 40 transects for English Camp. Sampling along line transects will provide annual estimates of physiognomic cover types and percent cover of areas dominated by native and exotic plant species (i.e., monitoring objectives 1 and 2).

The second stage of sampling involves a set of systematically located quadrats within two strata: native and exotic prairie. Quadrats will be located systematically, within each strata, along the line transects. Quadrat locations are not permanently marked and locations are calculated, each year, following transect surveys that delineate the strata (i.e. native and exotic prairie). We will use quadrat sampling to obtain information about status and trends of prairie quality and species composition (i.e., monitoring objectives 3 and 4).

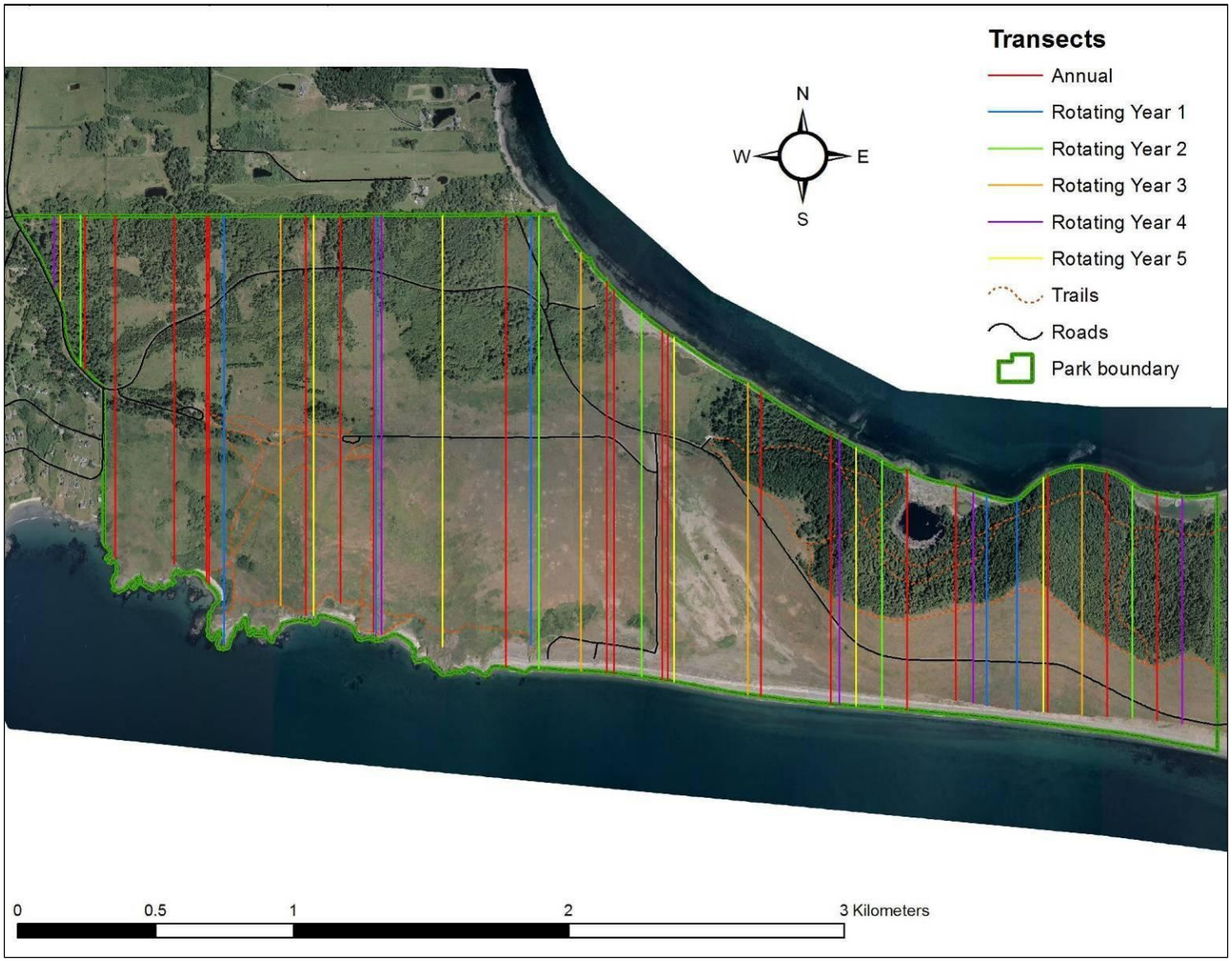


Figure 9. Distribution of line transects (*n*=45) at American Camp, San Juan Island National Historical Park.

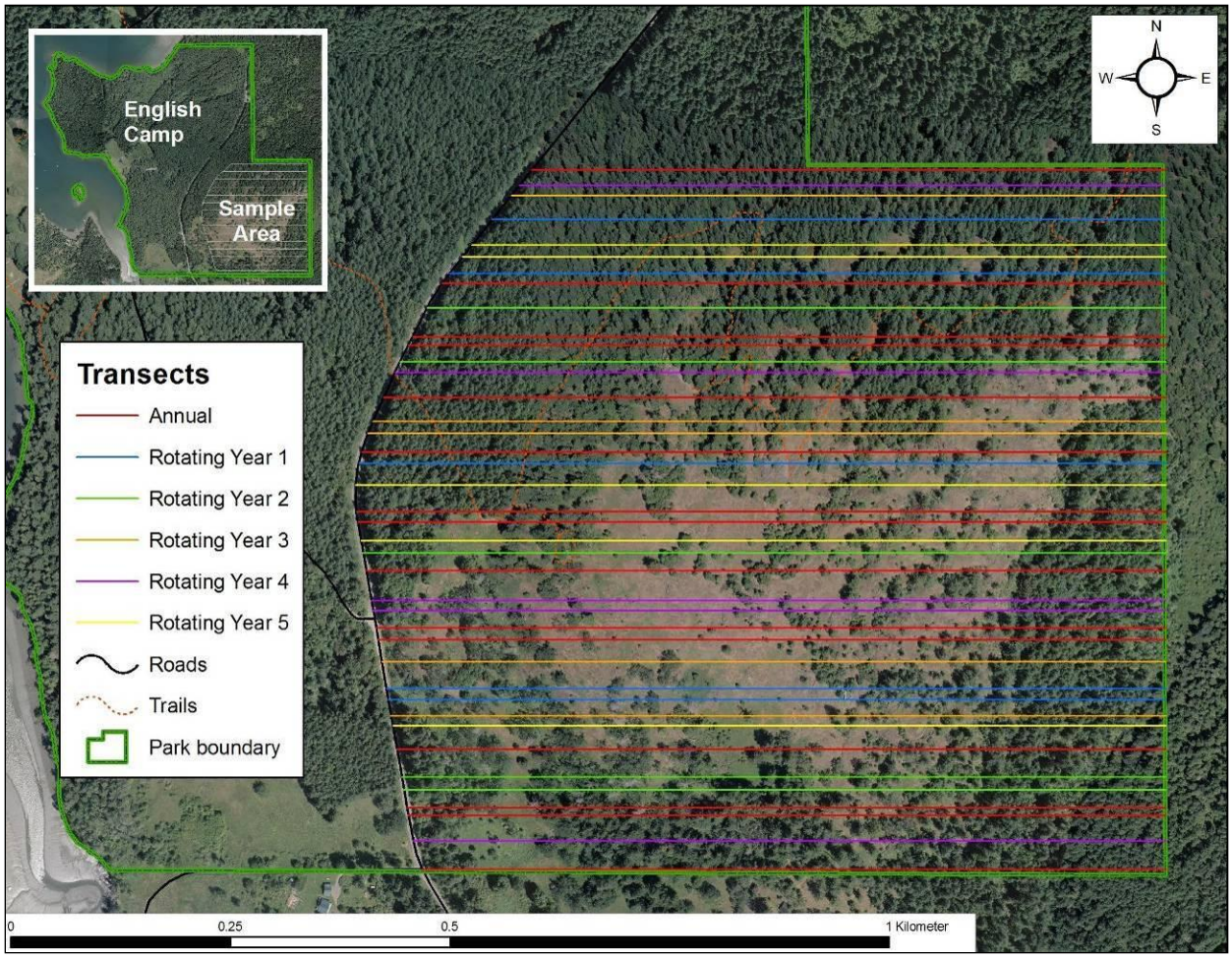


Figure 10. Distribution of line transects (*n=40*) at English Camp, San Juan Island National Historical Park.

Sample Frequency and Replication

A probability based sample of survey units throughout the area will allow unbiased estimation of monitoring parameters for the entire study area (American or English Camp). Each year, we will monitor a total of 25 transects at American Camp and 20 transects at English Camp. Transects are assigned to annual or rotating panels (Fuller 1999). Transects in the annual panel (20 in American Camp and 15 in English Camp) are revisited every year and rotating panels are sampled every five years (Panel 1 in Figures 9 and 10, Table 3). Each rotating panel is composed of five transects (Panels 2-6 in Figures 9 and 10). This design (i.e. annual and rotating panels) provides a total sample size of 45 transects for American Camp and 40 transects in English Camp.

The revisit design will balance the objectives for status and trend estimation equally as suggested by Urquhart et al. (1998), Breidt and Fuller (1999), Fuller (1999), and McDonald (2003). Visiting a set of sample units every year (in the annual panel) ensures low variance for trend estimates but the sites tend to "wear out" and obtain biases through conditioning, particularly when destructive sampling is used (Fuller 1999, McDonald 2003). Visiting a set of sites in alternating years (in a rotating panel) allows for the inclusion of more sites in the sample

(increasing the chance of observing rare elements) and results in low variance for the estimation of mean levels (status) within a year (Fuller 1999, McDonald 2003).

Table 3. Revisit design for monitoring. Each panel is a collection of sample units (transects) that are sampled at the same time. Numbers indicate the number of transects in each panel using American Camp as an example.

	Year																			
Panel Type	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Annual	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Rotating 1	5					5					5					5				
Rotating 2		5					5					5					5			
Rotating 3			5					5					5					5		
Rotating 4				5					5					5					5	
Rotating 5					5					5					5					5

Species composition and herbaceous (prairie) quality comprise the second stage of sampling and will be monitored using square, 1 m^2 quadrats distributed along each transect. Each transect will represent a sample and cover estimates from quadrats will be reported by stratum (i.e., exotic or native) per transect for analysis. Second stage sampling will be conducted annually during the first five years as a pilot study. The five year data summary and analysis report will provide recommendations for the long-term implementation of this stage of sampling.

Transects

Transects were selected to estimate status and monitor trends in cover types (see Table 4 and Figure 15), the proportion of areas dominated by native and exotic species cover, and as the method to distribute quadrats in the prairies. Physiognomic cover types are recoded along the transect utilizing line intercept methods (Butler and McDonald 1983).

Quadrats

Quadrat sampling shall take place in herbaceous cover types because we are interested in status and trend estimates of species composition and prairie quality. Quadrats will be centered and placed every 35 m along native and exotic herbaceous sections of the transect. Prairie quality will be reported by stratum (i.e., exotic, native) and transect to describe using the FQI and other diversity indices.

Table 4. Summary of cover types used to describe transect segments.

Cover Type	Definition
Trees	Any segment where the tallest vegetation is a tree species. In areas where trees are establishing in herbaceous vegetation, the cover type is tree if the tree is at least 1 m wide.
Shrubs	Shrubs are defined by species rather than growth form. All willows are shrubs (see Appendix B).
Herbaceous	All areas with herbaceous (non-woody) vegetation. This includes prairies, sand dunes, sand flats, and mowed lawns.
Unvegetated	Areas with <10% cover that are not roads, trails, or buildings. This category does include open bodies of water.
Developed	Roads, trails, and buildings that meet the minimum resolution for documentation (i.e., 1 m of the line transect). In some cases, small social trails or animal trails will not be documented.
Modifier	
Native	Any cover type where cover is ≥50% native. In trees or shrubs this applies to the overstory not the understory. So, if native trees are the tallest canopy class the cover type is called native even if there is an understory of exotic shrubs.
Exotic	Any cover type that does not have ≥50% cover by natives. An herbaceous site could have 52% cover of natives and 60% cover of exotic grasses, but this would be a native prairie (of low quality).
Rabbit Grazed	Area has evidence of rabbit grazing, pellets, or burrows that appear to have been made during the season of the survey
Substrate	**For use in Unvegetated Cover types**
Sand	Fine sand
Gravel	Loose rocks from pebble size to cobbles
Rock	Large or embedded rock substrate
Soil	Soil substrate other than sand
Logs	Beach logs
Water	Open water such as lagoons or ponds

C. Sample Size

Transects

As previously explained, we conducted a computer simulation to investigate statistical power to monitor trends in cover of native plant polygons prior to our first summer of field testing. The initial simulation was conducted using maps of native plant polygons that had been mapped during the vascular plant inventory for SAJH (Figure 6, Rochefort and Bivin 2010). Using our pilot data from 2009, with the incorporation of the observed mean and variance of the parameters of interest, we ran a second simulation to investigate a range of sampling intensities from 5 to 50 transects, and effect sizes ranging from 0.5% per year and 5% a year.

For each sampling intensity level, 1000 sets of random transect locations were generated (i.e. 1000 replications of the simulation). For each replication of the simulation, a random percent cover estimate was generated for each transect for year 1 from a normal distribution with the observed mean and variance of percent cover observed in 2009. Year 2 estimates of percent cover were generated from a normal distribution with the mean equal to the observed mean multiplied by the effect size and the observed variance. Year 3 estimates of percent cover were generated from a normal distribution with the mean equal to the year 2 mean multiplied by the effect size and the observed variance, with this pattern continuing until 10 years of data had been generated. The trend was calculated for each transect and the average trend was calculated across

transects. Power was calculated as the percentage of replications that detected a significantly non-zero trend.

Based on our 2009 pilot data, 47% of the transect area was classified as herbaceous vegetation in 2009 (variance of 509%, 48% coefficient of variation, CI: 38-56%). Of this, 19% of herbaceous vegetation was dominated by native species (variance of 144%, 67% coefficient of variation, CI: 15-24%). Extrapolating these figures to the full 505 ha of the park, we estimate that 238 ha (95% CI: 193-283 ha) of the SAJH is herbaceous, and 92 ha of this was dominated by native species (95% CI: 68-116 ha).

Although our power estimates tested a range of sampling intensities from 5 to 50 transects, we were most interested in calculating the power and effect size for a sample size of 45 because following our pilot sampling, we felt it was realistic to complete 25 transects per year (20 annual and 5 transects per year from the 5 rotating panels). For each parameter and effect size, power increases with increasing sample effort, as expected. The estimated power to detect a trend of 3% a year for the cover of herbaceous vegetation with 90% probability for the current sampling intensity (i.e. 25 per year and 45 total) was 0.89 (Figure 11). The power to detect a trend of 2% a year for the current sampling intensity was 0.60. The recommended sampling intensity, of 25 transects per year, has adequate power to detect a change in the cover of herbaceous vegetation for changes between 2 and 3% a year. The estimated power to detect a trend of 5% a year for the cover of native herbaceous vegetation, with 90% probability, for the current sampling intensity was 0.92 (Figure 12). The power to detect a trend of 3% a year for the current sampling intensity was 0.63. The current monitoring plan (i.e., 20 annual transects, 5 rotating panels of 5, total n=45) has adequate power to detect a 3-5 % change in the cover of native herbaceous vegetation per year.

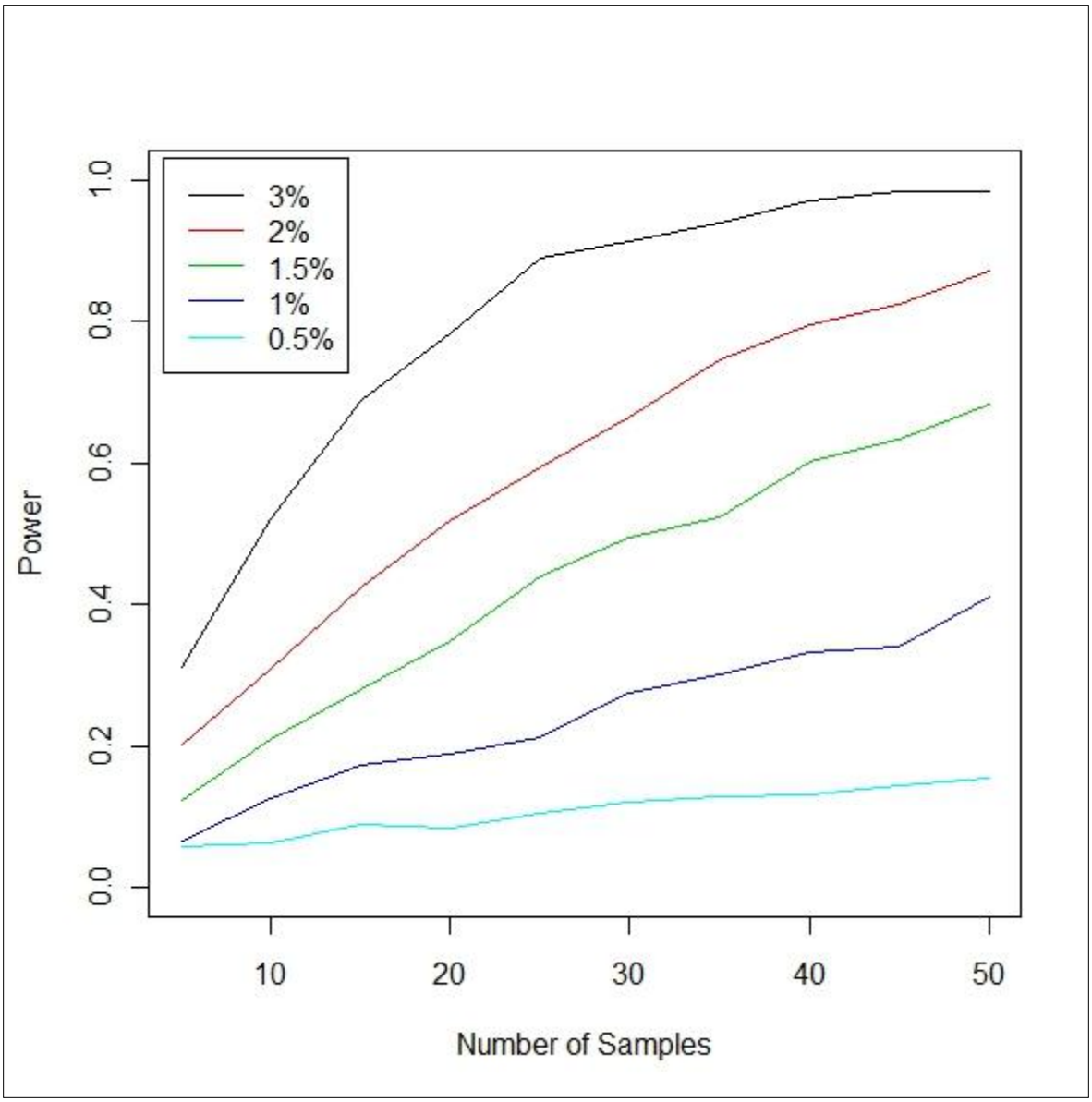


Figure 11. Power to detect a trend in the proportion of transect area classified as herbaceous with 90% probability for a monitoring plan with 5 to 50 transects sampled a year and effect sizes from .05% a year to 3% a year. Calculations are based on 2009 pilot data.

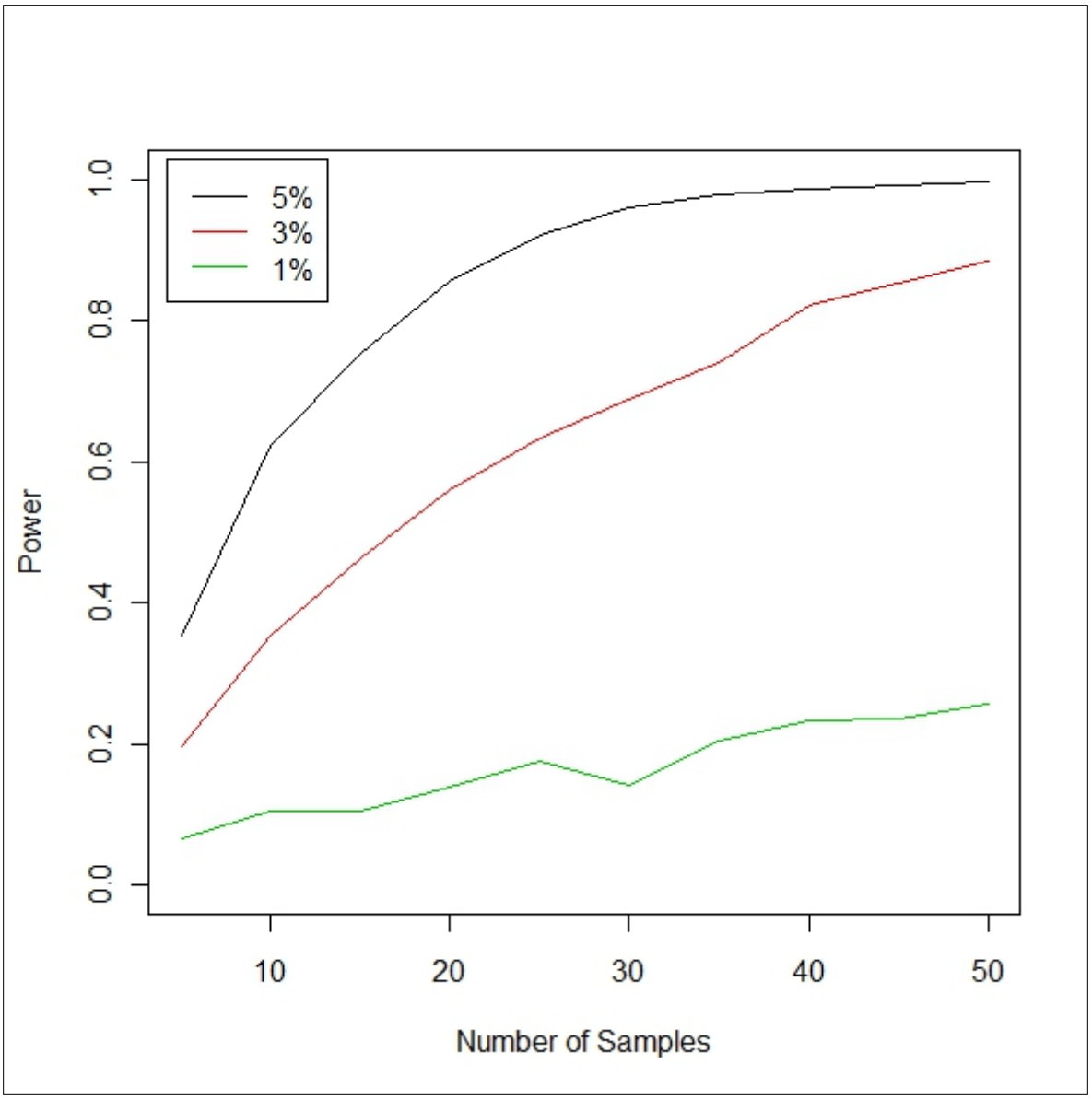


Figure 12. Power to detect a trend in the proportion of herbaceous areas dominated by native species with 90% probability for a monitoring plan with 5 to 50 transects sampled a year and effect sizes from 1% a year to 5% a year. Calculations are based on 2009 pilot data.

Quadrats

We used a computer simulation to investigate the statistical power obtained under various Stage Two sampling intensity levels. The intensity of sampling is defined by the spacing of quadrats along the transects, with a larger spacing resulting in fewer quadrats and a smaller spacing resulting in more quadrats. The simulation investigated the power to detect trends in native species diversity and the cover of native species with 90% probability (acceptable rate of type 1 error of 10%). Power was defined as the probability of rejecting the null hypothesis of no trend.

The number of transects in the annual panel of Stage One was set at 20. The sampling intensity varied from 1 quadrat every 10 meters along the native prairie sections of the transect, to 1

quadrat every 40 meters, in increments of 5. The simulation investigated a range of effect sizes from 1% per year to 3% per year. The observed mean and variance of the parameters of interest were taken from quadrat sampling conducted during field work for the SAJH vascular plant inventory (Rochefort and Bivin 2010).

For each combination of sampling intensity and effect size levels, 1000 sets of random transect locations were generated (i.e. 1000 replications of the simulation). For each replication of the simulation, a random estimate was generated for each quadrat for year 1 from a normal distribution with the observed mean and variance observed in the historic data. Year 2 estimates were generated from a normal distribution with the mean equal to the observed mean multiplied by the effect size and the observed variance. Year 3 estimates were generated from a normal distribution with the mean equal to the year 2 mean multiplied by the effect size and the observed variance, with this pattern continuing until 10 years of data had been generated. The trend was calculated for each transect and the average trend was calculated across transects. Power was calculated as the percentage of replications that detected a significantly non-zero trend.

There were 424 1 m^2 quadrats sampled during the SAJH inventory, of which 181 had more than 50% native vegetation cover. The observed mean native species diversity on the native quadrats was 3.9 with a variance of 3.9. The coefficient of variation in these data was 51%. The observed mean percentage cover of native vegetation was 93.07% with a variance of 988%. The coefficient of variation in these data was 34%.

For each parameter and effect size, power increases with increasing sample effort, or decreasing quadrat spacing, as expected. Power estimated to detect a decreasing trend of 2% a year for native diversity with 90% probability was 0.80 with quadrats spaced 35 m apart (Figure 13). To detect a 1% decreasing trend a year with 80% power the sampling intensity would involve quadrats spaced approximately every 10 meters. A monitoring plan with quadrats spaced between 10 and 35 meters will have adequate power to detect between a 1 and 2% change in native diversity a year.

Power estimated to detect a decreasing trend of 2% a year for the cover of native herbaceous vegetation with 90% probability was 0.81 with quadrats spaced 80 m apart along the native herbaceous portions of the transects (Figure 14). To detect a 1% decreasing trend a year with 80% power the sampling intensity would involve quadrats spaced approximately every 20 meters. A monitoring plan with quadrats spaced between 20 and 80 meters will have adequate power to detect between a 1 and 2% change in the cover of native herbaceous vegetation a year.

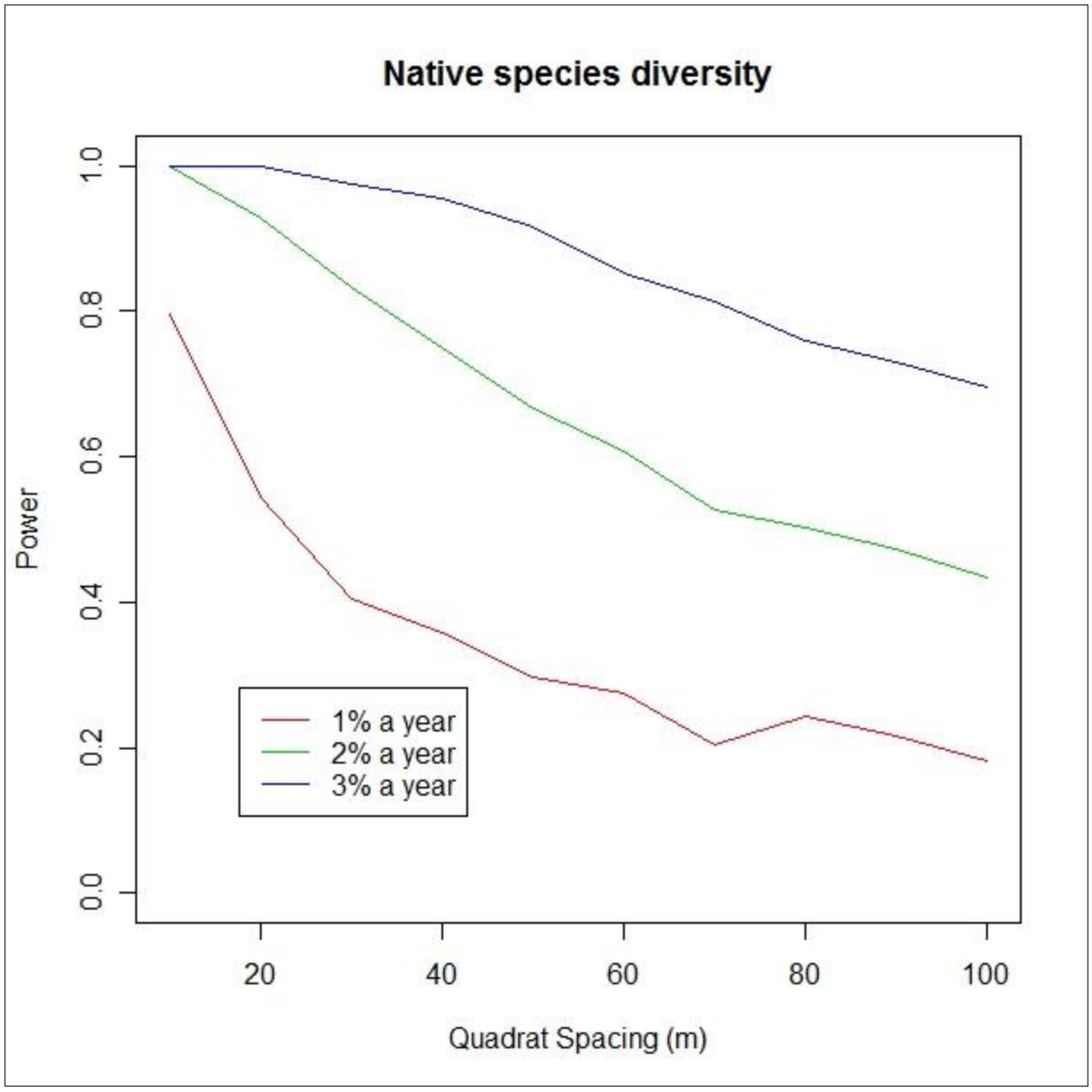


Figure 13. Power to detect a trend in native species diversity with 90% probability for a monitoring plan with quadrat spacing from 10 to 100 meters apart and effect sizes from 1% a year to 3% a year. Calculations are based on 2009 pilot data.

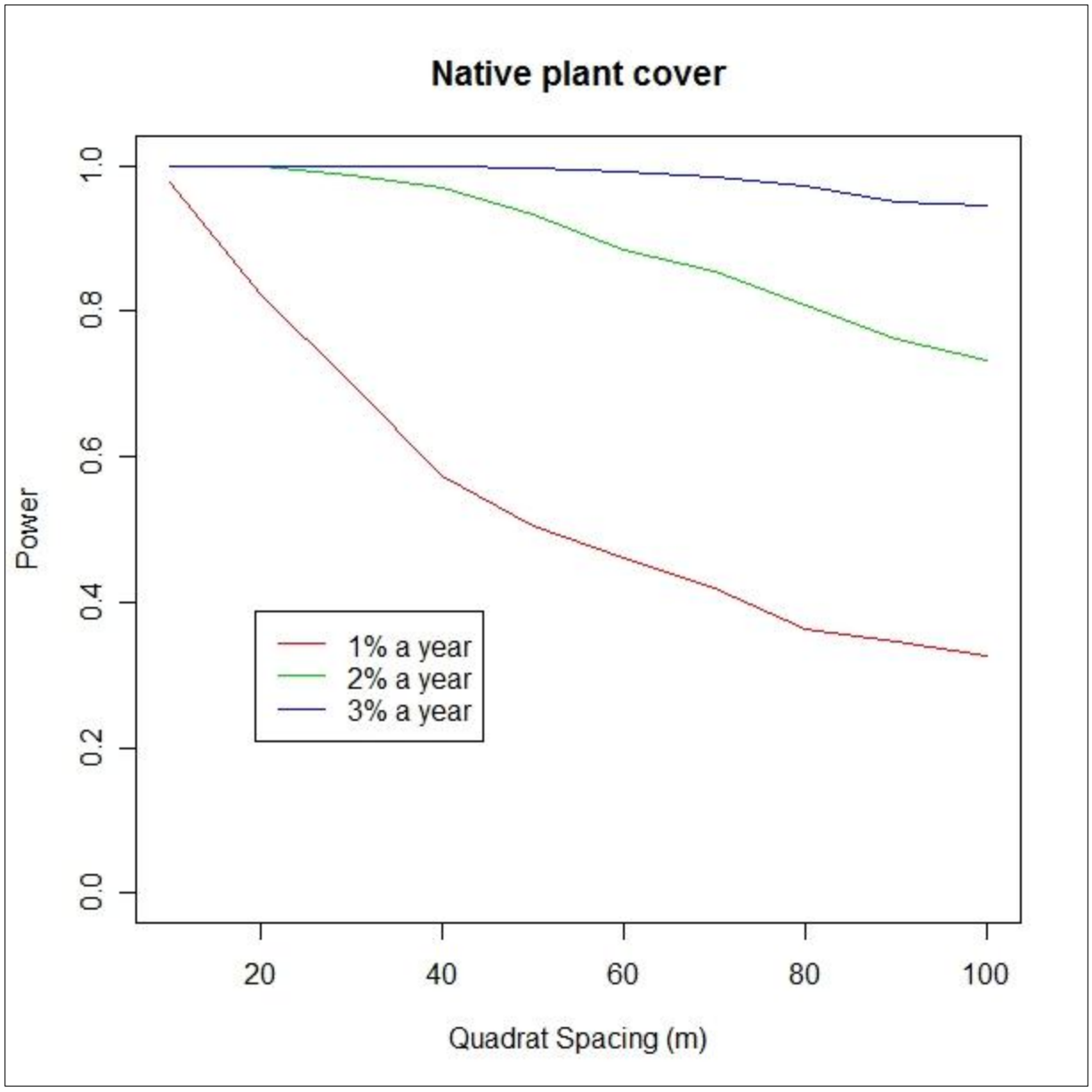


Figure 14. Power to detect a trend in percent cover of native species with 90% probability for a monitoring plan with quadrat spacing from 10 to 100 meters apart and effect sizes from 1% a year to 3% a year. Calculations are based on 2009 pilot data.

3. Field Methods

A. Field Season Preparations and Equipment Setup

The Prairie Monitoring Protocol requires a very short field season and is implemented during a 4-6 week period in May and early June. We propose to use a Field Lead and crew member based at SAJH to conduct all monitoring. The Chief of Resources from SAJH will hire and supervise the field crew. The Plant Ecologist from NOCA will serve as the Project Lead and will work with the Resource Chief at SAJH to train the field crew, ensure that equipment and database access is in place for the crew, and provide assistance as needed.

Beginning in February or March, equipment will be inventoried, including testing of breakable items such as GPS units, radios, and any needed items will be purchased. Data forms and task lists from the previous year will be copied on rain-proof paper and maps of the line transects will be loaded onto the GPS units. Locations of quadrats will be determined by the GIS Specialist using the current year's transect data and will be loaded onto GPS units. We have not included precise locations for transects in this protocol document to avoid compromising the security of their locations. Precise locations and directions are maintained in the project database and are provided to field crews as necessary in the Navigation Report. (See **SOPs 1, 2, 3**)

B. Sequence of Events During Field Season

Field crew training will be conducted at the beginning of May by the Project Lead with assistance from the GIS Specialist, Data Manager, and SAJH Resource Chief. Prior to monitoring the transects, crew members will be trained on operation of the GPS, physiognomic cover types, origin of vegetation species, data recording procedures, database uses, ocular cover estimation and quadrats methods. Transects will be monitored first, and once completed, quadrats will be monitored. GPS data will be downloaded daily and the Field Lead will review field forms for accuracy daily. Field form data will be entered into the database weekly and all data processing and the field season report will be completed by July 15 (see **SOPs 3 – 14** and **Appendix C: Yearly Project Task List**).

C. Permitting and Compliance

This activity involves day to day resource management or research activities. No compliance documentation is necessary.

D. Details of Taking Measurements

The prairie monitoring should be conducted between May 1 and mid-June. Transect monitoring is conducted first because it provides data to generate the quadrat locations and because it is less sensitive to plant phenology than the quadrat monitoring. Prairie forbs start emerging sometime in mid-April (depending on weather), bracken fern next, and grasses follow. Identification of native and exotic segments can be accomplished if native forbs (most of the lilies, *Abronia latifolia*) *Cirsium spp*., annual bromes, and several perennial grasses are identifiable. *Elymus glaucus, E. repens, Leymus mollis, Bromus sitchensis, Festuca roemerii, F. rubra var. littoralis* are the dominant grasses that are generally encountered during transect surveys. Surveys must be timed so that both early season forbs and the grasses are visible.

Transects

Transects can be efficiently conducted with a two person crew where one person is comfortable with plant identification and the second is able to operate the GPS. Depending on the length and complexity of the transect (i.e. number of cover types and number of times the transect goes through shrubs and forest), one to three transects can be completed within one work day. Each transect is a line that extends across the camp from one boundary to the other. Field observers walk along each transect navigating with a GPS that has real time, horizontal accuracy of <1 m. The line is divided into segments based on the cover type and modifier using a 1 m resolution. If a cover type extends for at least 1 m along the line, the beginning and end points are recorded; if a cover type extends for less than one meter it is not recorded. Cover types and modifiers are defined in Table 4, and Figure 15 illustrates the decision tree used by field observers.

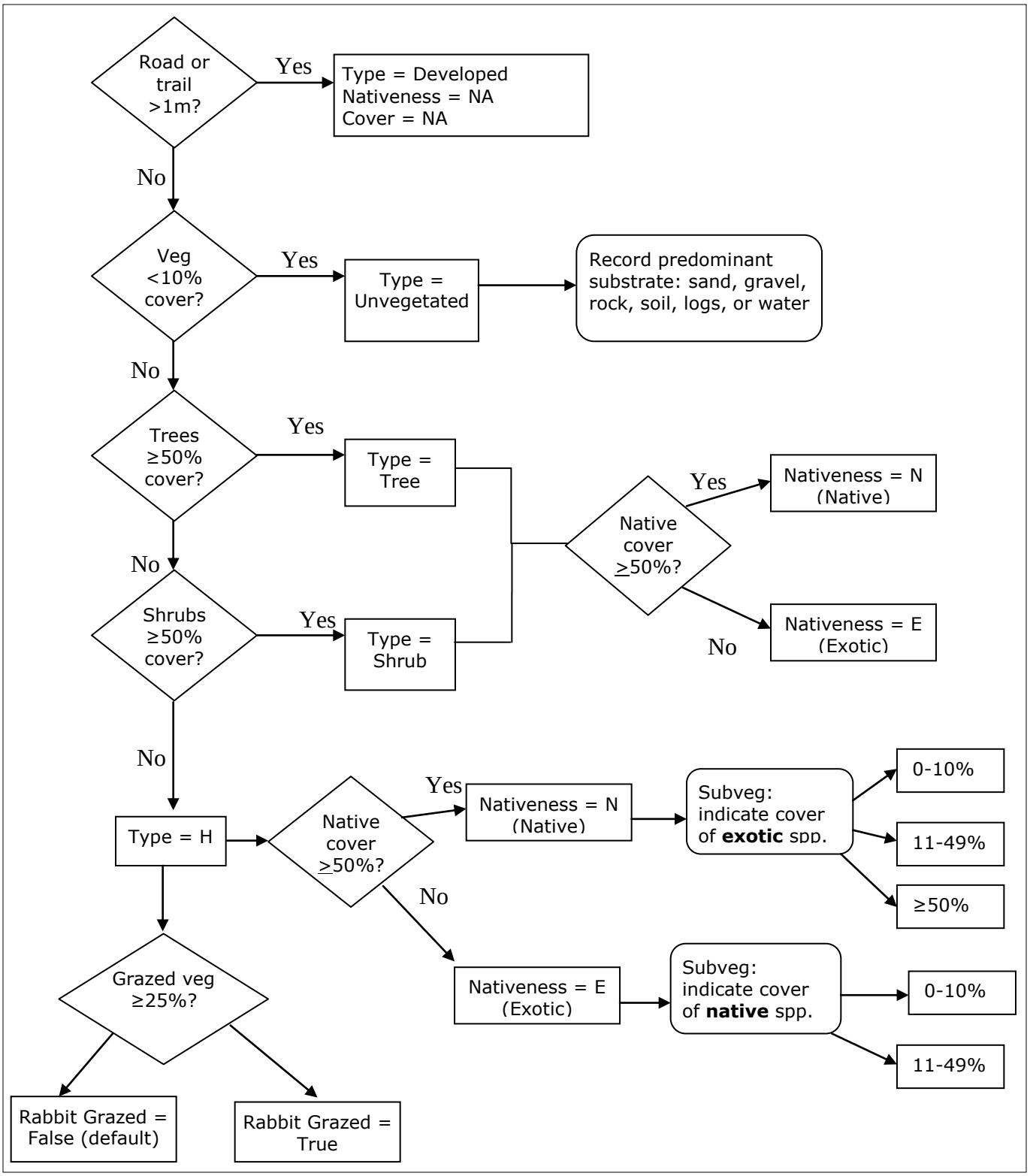


Figure 15. Diagram illustrating the hierarchy of cover types and the transect survey decision tree.

Quadrats

After the transects are surveyed and GPS data have been sent to the GIS specialist, quadrat locations will be determined, and quadrats should be surveyed within a month of the transect surveys. Although transect monitoring can be conducted while the grasses are still emerging, cover estimates in the quadrats rely on accurate estimation of cover of all species rather than just a few dominants. Quadrats must be monitored before leaves from early lilies have senesced (i.e., often mid to late May).

Quadrats are distributed proportionately in native and exotic dominated herbaceous vegetation. Cover of herbaceous vegetation along each transect is calculated for exotic and native cover types and quadrats are placed at the 35^{th} cumulative meter in each type (Table 5). A 1 m^2 quadrat will be centered on the line transect when the distance between quadrats has been obtained. The quadrat will be placed such that one edge will be at the specified distance and extend 1 m, with .5 m of the frame falling on either side of the transect.

Surface cover within each quadrat will initially be recorded in three broad categories: Total Vascular Vegetation, Total Non-vascular Vegetation, and Unvegetated surfaces. These three categories are used to provide a general description of the quadrat so, you should evaluate cover standing over the quadrat and looking down. Unvegetated surfaces will include roacks, bare soils, litter, and pebbles. The next step is ocular estimation of each species present in the quadrat. The presence of each vegetation species will be recorded in one of the following cover classes: >0-5%, >5-25%, >25-50%, >50-75%, >75-95%, and >95-100%. All vegetation species present should be recorded and assigned a minimum of >0-5% cover. The sum of the cover of all vegetation species can add to more than 100% if the vegetation is layered in the vertical dimension.

Table 5. Example describing distribution of herbaceous monitoring quadrats along line transects.

Line Transect (m)	Cover Type	Quadrat Location (m from origin)
0 - 10	Herbaceous, native	None
10 - 20	Herbaceous, exotic	None
20 – 25	Shrub, native	None
25 – 51	Herbaceous, native	50 m
51 – 60	Tree, native	None
60- 100	Herbaceous, exotic	85 m

E. End-of-Season Procedures

End of season procedures are described in **SOP 11: End of Season Debriefing and Close-out**. The equipment will be put away and anything that is damaged or missing will be documented. In addition, crew leads will prepare a brief field season report that will enumerate on which transects vegetation cover types were mapped and which plots were sampled and describes any logistic difficulties that arose and explains how they were addressed. The report must clearly document and explain any diversions from established protocols. Finally, it should point out any interesting observations and provide suggestions for improving the training or field season procedures for the future. These reports will be archived.

The Project Lead, SAJH Resource Chief, NCCN Vegetation group members, Data Manager, and GIS Specialist will hold an end of season meeting each year. The purpose of the meeting will be to discuss the results of the current year, to review methods, discuss data analysis, and recommendations for upcoming seasons. These meetings will be particularly important during the first five years and during the five year review because field and analysis methods may still need some revisions during this initial period.

4. Data Management, Analysis and Reporting

This chapter describes the procedures for data management, analysis, and report development. Additional details and context for this chapter are provided in the NCCN Data Management Plan (Boetsch et al. 2009), which describes the overall information management strategy for the network. The NCCN website (http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm) also contains guidance documents on various information management topics (e.g., report development, GIS development, GPS use).

A. Project Information Management Overview

Project information management may be best understood as an ongoing or cyclic process, as shown in Figure 16. Specific yearly information management tasks for this project and their timing are described in **Appendix C: Yearly Project Task List**. Readers may also refer to each respective chapter section for additional guidance and instructions.

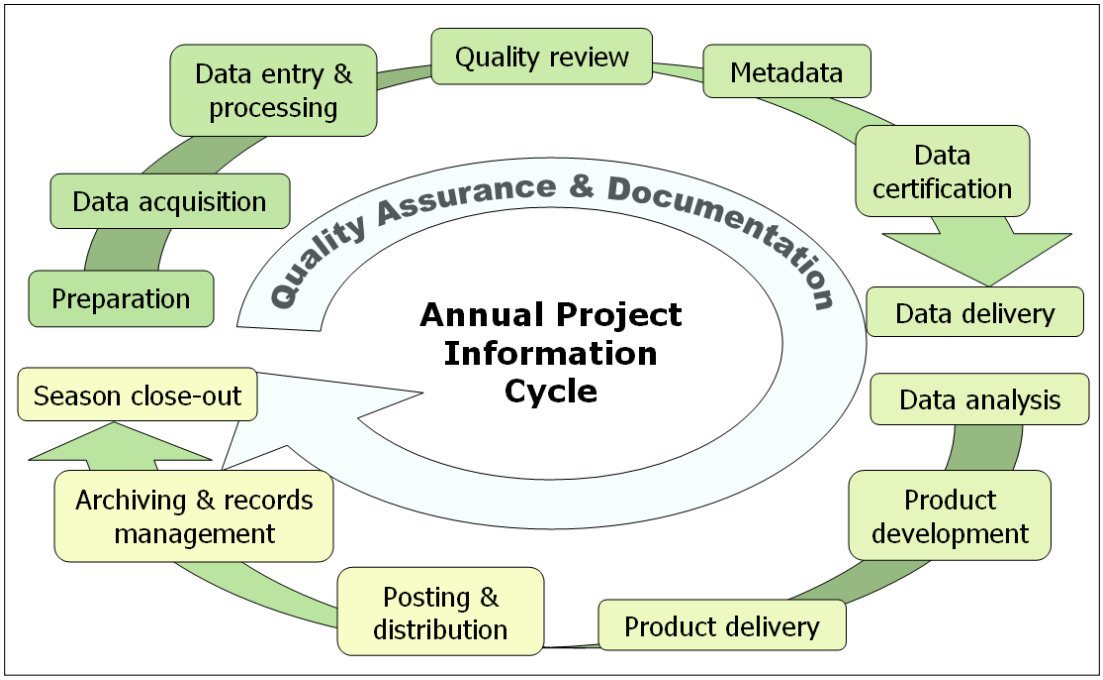


Figure 16. Idealized flow diagram of the cyclical stages of project information management, from pre-season preparation to season close-out. Note that quality assurance and documentation are thematic and not limited to any particular stage.

The stages of this cycle are described in greater depth in later sections of this chapter, but can be briefly summarized as follows:

- *Preparation* – Training, logistics planning, print forms and maps.
- *Data acquisition* – Field trips to acquire data.
- *Data entry & processing* – Data entry and database uploads, GPS data processing, etc.
- *Quality review* – Data are reviewed for structural integrity, completeness and logical consistency.
- *Metadata* – Documentation of the year's data collection and results of the quality review.

- *Data certification* – Data are certified as complete for the period of record.
- *Data delivery* – Certified data and metadata are delivered for archiving.
- *Data analysis* – Data are summarized and analyzed.
- *Product development* – Reports, maps, and other products are developed.
- *Product delivery* – Deliver reports and other products for posting and archiving.
- *Posting & distribution* – Distribute products as planned and/or post to NPS clearinghouses.
- *Archiving & records management* – Review analog and digital files for retention (or destruction) according to NPS Director's Order 19. Retained files are renamed and stored as needed.
- *Season close-out* – Review and document needed improvements to project procedures or infrastructure, complete administrative reports, and develop work plans for the coming season.

B. Pre-season Preparations for Information Management

Project Workspace Setup

A section of a networked file server is reserved for this project, and access privileges are established so that project staff members have access to needed files within this workspace. Prior to each season, the Project Lead should make sure that network accounts are established for each new staff member, and that the Data Manager is notified to ensure access to the project workspace and databases. Workspace structure, naming conventions, and additional details are provided in **SOP 1: Project Workspace and Records Management**.

GPS Loading and Preparation

The GIS Specialist and Project Lead should work together to ensure that target coordinates and data dictionaries are loaded into the GPS units prior to the onset of field work, and that GPS download software is available and ready for use. Additional details on GPS use and GPS data handling are provided in **SOP 5: GPS Use** and in NCCN GPS Guidelines (NCCN 2009).

Project Database Application

Prior to the field season, the Data Manager will update the project database application as needed to ensure proper access on the part of the project staff. Refer to **Section 4C, Overview of Database Design** for additional information about the database design and implementation strategy.

C. Overview of Database Design

We maintain a customized relational database application to store and manipulate the data associated with this project. The design of this database is consistent with NPS I&M and NCCN standards. The Data Manager is responsible for development and maintenance of the database, including customization of data summarization and export routines.

The database is divided into two components – one for storing data in a series of related tables composed of fields and records (i.e., the "back-end database"), and another that acts as a portal or user interface through which data may be entered, viewed, edited, error-checked, summarized and exported (i.e., the "front-end application"). By splitting the database into front-and back-end

components, multiple users may interact with the data simultaneously, and user interface updates can be implemented without service disruptions.

The back-end database schema (tables, fields and relationships) is documented in **Appendix D: Prairie Vegetation Monitoring Protocol Database Documentation**. The back-end database is implemented in Microsoft SQL Server to take advantage of the automated backup and transaction logging capabilities of this enterprise database software.

The front-end is implemented in Microsoft Access. It contains the forms, queries, and formatted report objects for interacting with the data in the back-end. Its features and functionality are customized using Visual Basic for Applications (VBA) programming code. The application has separate forms for data entry that mirror the layout of hard-copy field forms used during data collection. There are also forms for browsing and editing data, for completing the annual quality review, and for summarizing and exporting data to other software (e.g., for analysis and graphics production).

D. Data Entry and Processing

During the field season, the project crew will be provided with a copy of the project database front-end, through which they enter, process, and quality-check data for the current season.

Technicians should enter data as soon as possible after each field trip in order to keep current with data entry tasks, and to identify any errors or problems as close to the time of data collection as possible. The front-end database application is found in the project workspace. For enhanced performance, it is recommended that users copy the front-end onto their workstation hard drives and open it there. This front-end copy may be considered "disposable" because it does not contain any data, but rather acts as a pointer to the data that reside in the back-end database. Whenever updates to the front-end application are made available by the Data Manager, an updated front-end should be copied from the project workspace to the workstation hard drive.

The functional components of the front-end application are described in **SOP 10: Data Entry and Verification**. Each data entry form is patterned after the layout of the corresponding field form, and has built-in quality assurance components such as pick lists and validation rules to test for missing data or illogical combinations. Although the database permits users to view the raw data tables and other database objects, users are strongly encouraged to use only these pre-built forms as a way of ensuring maximum data quality.

Regular Data Backups

Automatic database backups are scheduled in the SQL Server database management system to help prevent data loss in case of user error, drive failure, or database file corruption. Full backups are scheduled on a weekly basis, with daily transactional backups to enable restore operations to a point in time within a moving eight-week window. Weekly backups and transaction files are retained for eight weeks to conserve drive space. Full monthly backups are stored for at least one year after data have been certified. Snapshot backup copies of certified data, made at the time of certification, are retained indefinitely.

Data Verification

As data are being entered, the person doing the data entry should visually review them to make sure that the data on screen match the field forms. This should be done for each record prior to moving to the next form for data entry. At regular intervals and at the end of the field season the Field Lead should inspect the data being entered to check for completeness and perhaps identify avoidable errors. The Field Lead may also periodically run the Quality Assurance Tools that are built into the front-end database application to check for logical inconsistencies and data outliers (this step is described in greater detail in **Section 4E, Data Quality Review** and also in **SOP 12: Data Quality Review and Certification**).

Field Form Handling Procedures

As field data forms are part of the permanent record for project data, they should be handled in a way that preserves their future interpretability and information content. If changes to data on the forms need to be made subsequent to data collection, the original values should not be erased or otherwise rendered illegible. Instead, changes should be made as follows:

- Draw a horizontal line through the original value, and write the new value adjacent to the original value with the date and initials of the person making the change.
- All corrections should be accompanied by a written explanation in the appropriate notes section on the field form. These notes should also be dated and initialed.
- If possible, edits and revisions should be made in a different color ink to make it easier for subsequent viewers to be able to retrace the edit history.
- Edits should be made on the original field forms and on any photocopied forms.

These procedures should be followed throughout data entry and data revision. On an annual basis, data forms are to be scanned as PDF documents and archived (see the product delivery specifications in **SOP 13: Product Delivery, Posting and Distribution**). The PDF files may then serve as a convenient digital reference of the original if needed.

Image Handling Procedures

This section covers photographic images collected by project staff or volunteers during the course of conducting project-related activities. Images that are acquired by other means – e.g., downloaded from a website or those taken by a cooperating researcher – are not project records and should be filed and named in such a way that they will not be confused with project records.

Care should be taken to distinguish data photographs from incidental or opportunistic photographs taken by project staff. Data photographs are those taken for at least one of the following reasons:

- To document a particular feature or perspective for the purpose of site relocation
- To capture site characteristics and possibly to document gross structural changes over time
- To document a species detection that is also recorded in the data

Data photographs are often linked to specific records within the database, and are stored in a manner that permits the preservation of those database links. Other photographs – e.g., of field

crew members at work, or photographs showing the morphology or phenology of certain plant species – may also be retained but are not necessarily linked with database records.

Refer to **SOP 9: Managing Photographic Images** for details on how to handle and manage image files.

GPS Data Procedures

The following general procedures should be followed for GPS data (see **SOP 5: GPS Use** and **Appendix C: Yearly Project Task List**):

1. GPS data should be downloaded by the field crew from the units at the end of each field trip and stored in the project workspace (see **SOP 1: Project Workspace and Records Management**).
2. Raw files should be sent in a timely manner to the GIS Specialist for processing and correction.
3. The GIS Specialist will process the raw GPS data and store the processed data in the project workspace.
4. The GIS Specialist will upload corrected coordinate information into the database and create or update any project GIS data sets as needed.

The Field Lead should periodically review the processed GPS data to make sure that any errors or inconsistencies are identified early.

E. Data Quality Review

After the data have been entered and processed, they need to be reviewed by the Project Lead for structural integrity, completeness and logical consistency. The front-end database application facilitates this process by showing the results of pre-built queries that check for data integrity, data outliers and missing values, and illogical values. The user may then fix these problems and document the fixes. Not all errors and inconsistencies can be fixed, in which case a description of the resulting errors and why edits were not made is documented and included in the metadata and certification report (see **Sections 4F, Metadata Procedures** and **4G**, **Data Certification and Delivery**, and **SOP 12: Data Quality Review and Certification**).

Data Edits After Certification

Due to the high volume of data changes and/or corrections during data entry, it is not efficient to log all changes until after data are reviewed and certified. Prior to certification, daily backups of the database provide a crude means of restoring data to the previous day's state. After certification, all edits to certified records are tracked in an edit log (refer to **Appendix D: Prairie Vegetation Monitoring Protocol Database Documentation**) so that future data users will be aware of changes made after certification. In case future users need to restore data to the certified version, we also retain a separate, read-only copy of the original, certified data for each year in the project workspace.

Geospatial Data

The Project Lead and GIS Specialist may work together to review the surveyed coordinates and other geospatial data for accuracy. The purpose of this joint review is to make sure that geospatial data are complete and reasonably accurate, and also to determine which coordinates will be used for subsequent mapping and field work.

F. Metadata Procedures

Data documentation is a critical step toward ensuring that data sets are usable for their intended purposes well into the future. This involves the development of metadata, which can be defined as structured information about the content, quality, condition and other characteristics of a given data set. Additionally, metadata provide the means to catalog and search among data sets, thus making them available to a broad range of potential data users. Metadata for all NCCN monitoring data will conform to Federal Geographic Data Committee (FGDC) guidelines and will contain all components of supporting information such that the data may be confidently manipulated, analyzed and synthesized.

At the conclusion of the field season (according to the schedule in **Appendix C: Yearly Project Task List**), the Project Lead will be responsible for providing a completed, up-to-date metadata interview form to the Data Manager. The Data Manager and GIS Specialist will facilitate metadata development by consulting on the use of the metadata interview form, by creating and parsing metadata records from the information in the interview form, and by posting such records to national clearinghouses.

An up-to-date metadata record is a required deliverable that should accompany each season's certified data. For long-term projects such as this one, metadata creation is most time consuming the first time it is developed – after which most information remains static from one year to the next. Metadata records in subsequent years then only need to be updated to reflect changes in contact information and taxonomic conventions, to include recent publications, to update data disposition and quality descriptions, and to describe any changes in collection methods, analysis approaches or quality assurance for the project.

Specific procedures for creating, parsing and posting the metadata record are provided in NCCN Metadata Development Guidelines (NCCN 2007). General procedures are as follows:

1. After the annual data quality review has been performed and the data are ready for certification, the Project Lead (or a designee) updates the metadata interview form.
    a. The metadata interview form greatly facilitates metadata creation by structuring the required information into a logical arrangement of 15 primary questions, many with additional sub-questions.
    b. The first year, a new copy of the NCCN Metadata Interview form (available at: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm) should be downloaded. Otherwise the form from the previous year can be used as a starting point, in which case the Track Changes tool in Microsoft Word should be activated in order to make edits obvious to the person who will be updating the XML record.
    c. Complete the metadata interview form and maintain it in the project workspace. Much of the interview form can be filled out by cutting and pasting material from other documents (e.g., reports, protocol narrative sections, and SOPs).
    d. The Data Manager can help answer questions about the metadata interview form.
2. Deliver the completed interview form to the Data Manager according to the product delivery instructions in **SOP 13: Product Delivery, Posting and Distribution**.
3. The Data Manager (or GIS Specialist for spatial data) will then extract the information from the interview form and use it to create and update an FGDC- and NPS-compliant

metadata record in XML format. Specific guidance for creating the XML record is contained in NCCN Metadata Development Guidelines (NCCN 2007).
4. The Data Manager will post the record and certified data to the NPS Data Store, and maintain a local copy of the XML file for subsequent updates.
5. The Project Lead should update the metadata interview content as changes to the protocol are made, and each year as additional data are accumulated.

G. Data Certification and Delivery

Data certification is a benchmark in the project information management process that indicates that: 1) the data are complete for the period of record; 2) they have undergone and passed the quality assurance checks (**Section 4E, Data Quality Review**); and 3) they are appropriately documented and in a condition for archiving, posting and distribution as appropriate. Certification is not intended to imply that the data are completely free of errors or inconsistencies that may or may not have been detected during quality assurance reviews.

To ensure that only quality data are included in reports and other project deliverables, the data certification step is an annual requirement for all tabular and spatial data. The Project Lead is the primary person responsible for completing an NCCN Project Data Certification Form, available at: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm. This brief form should be submitted with the certified data according to the timeline in **Appendix C: Yearly Project Task List**. Refer to **SOP 12: Data Quality Review and Certification** and the delivery specifications in **SOP 13: Product Delivery, Posting and Distribution** for specific instructions.

H. Data Analysis: Status and Trends and Floristic Quality Indices

We propose two basic types of analyses. The first is designed to estimate the value of a parameter at a particular point in time. Examples of this type of analysis include estimating the extent of native prairie. Status estimates of cover may be particularly useful at the park level in developing work plans for exotic plant control. Since exotic plant control efforts generally focus on patches, the transect data will provide locations of patches for control efforts and when analyzed over several years, information on efficacy of control efforts. Second, there are analyses designed to detect long-term steady changes. Examples of this type include detecting an increase in cover on an individual transect or for the park, or estimating the average annual change in number of grass species in quadrats of native prairie. One inference scenario utilizes data from a single transect to make inferences to that transect. Examples include averages of species diversity from quadrat data in native prairie on a given transect. The other inference scenario is of more interest and assumes data from multiple transects will be analyzed to make inference about a parameter defined in a particular region or the entire unit. For example, researchers may need to decide whether the overall extent of native prairie is decreasing in American Camp.

The general statistical procedures proposed to accomplish each type of analysis under both inference scenarios are listed in Table 6. Many of the procedures making inference to a specific transect are time series analyses because they analyze a single number per transect and repeated measurements through time are required to assess variation. Responses are not replicated on a transect in a given year. Unit-wide inferences, on the other hand, utilize or incorporate transect-to-transect variation to quantify inferences.

Table 6. Summary of analysis procedures to achieve two objectives under two inference scenarios.

	Inference	
Analysis Goal	**Site specific**	**Regional**
Status Estimation	Mean Coefficient of Variation (CV) Histogram Cumulative Frequency Distribution (CDF)	Mean Coefficient of Variation (CV) Histogram Cumulative Frequency Distribution (CDF)
Trend Detection	Regression on time	Mixed linear model

Single Transect Status Estimation Procedures

Mean, Standard Deviation, and Coefficient of Variation (CV): For responses that are replicated within transect (e.g., quadrats within native prairie on a transect), the simplest estimates of current status involve calculating the mean, standard deviation, and coefficient of variation (= standard deviation / mean) of the response using values measured on the transect. For example, species diversity might be averaged for all quadrats in native prairie on a given or subset of transects. An estimate of the variation in species diversity is the standard deviation and CV of the individual numbers. A 95% confidence interval for the true mean response is $\bar{X} \pm 1.96 se(\bar{X})$ if individual measurements are approximately normally distributed. If a particular response is not approximately normal, bootstrap methods (Manly 1997) should be employed to construct appropriate confidence intervals. Bootstrap methods are recommended over "normalizing" transformation for two reasons. First, bootstrap methods utilize original measurement units that do not need to be back-transformed for interpretation, and second, confidence intervals based on transformations only approximate confidence intervals produced by bootstrapping. In other words, bootstrap methods are preferred because they do not rely on normality and while transformations may be successful in improving the distribution of the response, they cannot make distributions perfect.

For responses that produce one number per transect, (such as cover by native prairie), the current estimate of status is the observed number. In some cases, it may be possible to compute a standard error for this number based on a model or past data, but in general variation of these responses will be assessed through time.

Distribution Estimation: For responses that are measured many times on a given transect, it may be possible to construct plots that depict the response's entire distribution. These plots include histograms, box and whisker plots (Venables and Ripley 1999, p. 122), smoothed density estimates (Venables and Ripley 1999, Section 5.6), and cumulative frequency distribution plots. Standard histograms divide the range of a response into a number of bins and plot the number of measurements in each bin. Box and whisker plots show outliers and the 25^{th}, 50^{th}, and 75^{th} quartiles of the distribution of a response at various levels of another variable. For example, the distribution of number of species per square meter could be depicted in native prairie. Smoothed density plots use kernel estimation techniques (Wand and Jones 1995) to produce a smoothed histogram. Cumulative distribution functions plot the proportion of measurements below all observed levels of a response, and can be constructed from smoothed or non-smoothed

histograms. Cumulative frequency distributions can also be estimated using the methods of Diaz-Ramos et al. (1996)

It is anticipated that few responses will be replicated enough times within transects to make distributional estimates useful. These types of status estimates will be more useful when Camp wide data from multiple transects are combined. Methods for constructing these plots are similar under transect specific and Camp-wide inference (or regions within a Camp), and the reader is referred to the next section for specific examples of the plots.

Unit-wide Inference Status Estimation

Mean, Standard Deviation, and Coefficient of Variation (CV): The primary method of estimating status in a unit (region of inference, i.e., American Camp and English Camp) containing multiple transects will be to estimate the parameter's mean and an associated confidence interval. In these analyses, within transect variation will generally be smaller than variation between transects.

Assuming one measurement of a response is taken on each transect, an estimate of the current average of a parameter is simply the average of that parameter's value over all sampled transects in the unit. Variation of the average parameter estimate can be estimated by the usual standard deviation, or with the neighborhood variance estimator of Stevens and Olsen (2003). The neighborhood estimator should be used when possible because it takes into account spatial placement of sampled transects and any potential correlation induced by close proximity. Standard or bootstrap 95% confidence intervals for the true mean can be constructed for current status estimates, depending on approximate normality of the underlying responses.

Histogram and Cumulative Frequency Distribution (CDF): When the unit contains a large number of transects, it will be useful to estimate the statistical distribution of transect-level measurements across the unit. Histograms and associated smoothed density estimates can be estimated using the methods of Wand and Jones (1995) from data collected in the current year. Cumulative frequency distributions can be estimated using the methods of Diaz-Ramos et al. (1996). From either of these analyses, it will be possible to estimate the current proportion of transects in the Camp (region) that meet a specified condition. For example, it will be possible to estimate the proportion of transects with classified as native prairie $< x$ *(e.g., x = 20%)*, and place a confidence interval around the estimate.

Single Transect Trend Analyses: Regression on Time

A simple mixed or fixed effect linear model for trend is similar to the linear model for abrupt change analysis except that all responses, including those from the current year, are included in the response vector. The coefficient vector is estimated using an appropriate technique (either least-square, the REML method for correlated data, or blocked bootstrap) and inference about the single slope parameter is made. If the slope parameter β_1 is significantly different from zero, significant trend has been detected.

Regional Trend Analysis: Mixed Linear Model

When multiple transects are involved in a trend analysis, it is important to conduct the analysis in a way that cancels inherent differences between transects. As such it is only possible to include a transect in the analysis if it has been visited at least twice. Varying revisit intervals do not matter provided several transects have been visited every year in the [1-0] panel.

Assuming approximately normal response values, the trend analysis proposed by Piepho and Ogutu (2002) views responses as repeated measures and estimates a mixed linear model. The mixed linear model of Piepho and Ogutu (2002) assumes

$$y_{ij} = \mu + w_j\beta + b_j + a_i + w_j t_i + c_{ij}$$

where y_{ij} is the response on the ith transect during the jth year, w_j is the year covariate equal to the year that y_{ij} was recorded, μ is the fixed intercept parameter, β is the fixed overall slope parameter that we wish to make inference about, b_j is the random effect of the jth year, a_i and t_i are random effects of the ith transect, and c_{ij} is the random effect of transect and year combined (i.e., interaction). Using REML, it is possible to obtain an estimate of the fixed overall slope parameter β accounting for correlation in the random effects, and test whether or not β is significantly different from zero. If β is significantly different from zero, significant trend has been detected.

Floristic Quality Indices

Floristic Quality Assessment (FQA) refers to a suite of indices (Table 7) that revolve around Coefficient of Conservatism (C) values (Swink and Wilhelm 1979). C values are assigned to native species based on their fidelity to natural habitats and disturbance regimes. C values can be summarized into three broad groups: 0-3, weedy generalists that can grow in highly degraded areas; 4-6, species that can sustain moderate amounts of anthropogenic disturbance and are often found in remnant native areas; and 7-10, species with high affinities for natural conditions and disturbance regimes (Swink and Wilhelm 1979). These indices can provide a rapid assessment of habitat quality and are often used in conjunction with species cover, exotic or native species richness, or weed scores (Bowers and Boutin 2008).

Table 7. Definition of terms used in Floristic Quality Assessment.

Term	Definition
C or Coefficient of Conservatism	value of 0 to10 that is assigned to native species to indicate their fidelity to natural habitats, generally applied to native species
N	number of native species
S	total number of species (exotic and native)
Native Mean C (Native $\overline{C}$)	$(\sum_{i=1}^{N} CC)$/N
Total Mean C ($\overline{C}$)	$(\sum_{i=1}^{S} CC)$/S
Native Floristic Quality Index (FQI_N)	$\overline{C} * \sqrt{N}$
Total Floristic Quality Index (FQI_S)	$\overline{C} * \sqrt{S}$
Weed Score	value of (-1) to (-3) assigned to exotic species that estimates their difficulty to control

Two commonly used indices are the mean C and the Floristic Quality Index (FQI). Mean C and FQI are based on presence/absence, so they do not reflect dominance of native species or species richness and are often used in conjunction with other vegetation metrics such as species cover, richness, or exotic species richness. For example, Taft et al. (2006) used both FQI (average C multiplied by the square root of native species richness) and mean C to evaluate prairie remnants and reconstructed prairies in Illinois. Klips (2004) monitored vegetation change over a nine year period (1989-1998) in a restored prairie in Ohio and found C values useful when comparing the changes in species composition over time and in comparing the 1998 status of the restored prairie to a remnant.

The Floristic Quality Index (FQI) weights the Mean C by the square root of the species richness (Mean C($\sqrt{N}$) or Mean C($\sqrt{S}$)) and was the original metric presented by Swink and Wilhelm (1979 and 1994). However, Rooney and Rogers (2002) recommend the use of Mean C rather than FQI to minimize the effects of sampling intensity. They compared calculations of FQI, mean C, and species richness using 120 plots in a hardwood stand in Michigan and illustrated that mean C (or modified FQI in their terms) was less sensitive to sample size than FQI. Jog et al. (2006) conducted a similar comparison of FQI and mean C and found that while use of the two indices resulted in similar overall results, there were subtle differences between the two. The felt that FQI was helpful in their situation because they had equal sample sizes and were examining pastures with low native species diversity. They recommend comparison of the two indices based on the specific monitoring or research question.

We intend to utilize several measures when evaluating the quality of herbaceous communities: mean C, FQI, native species richness, native species cover, exotic species cover, and weed score (Table 8). The value of FQI scores will vary from community to community based on the number and composition of native species. Taft et al. (2006) used FQI to evaluate prairie remnants and reconstructed prairies in Illinois and calculated FQI scores ranging from 12.99 in reconstructed prairies to 40.32 in remnants. In a preliminary analysis of native prairie patches at American Camp, SAJH, we calculated FQI scores ranging from 0.1 to 15.6 (Table 9). It will be very important for us to identify the FQI or C ranges that indicate healthy and degraded prairie communities. During the first five years of prairie monitoring, we will review these metrics annually with SAJH park managers and EPMT Program leads to determine which indices are most helpful as both rapid assessment tools and as aids in the interpretation of long-term plant community trends (e.g., Klips 2004).

Table 8. Floristic Quality Index and proposed application.

Index	Application	Time Frame
Native Mean C (Native $\overline{C}$)	quadrat, transect, community, exotic vs. native prairies	annual, five year trends
Total Mean C ($\overline{C}$)	quadrat, transect, community, exotic vs. native prairies	annual, five year trends
Native Floristic Quality Index (FQI_N)	quadrat, transect, community, exotic vs. native prairies	annual, five year trends
Total Floristic Quality Index (FQI_S)	quadrat, transect, community, exotic vs. native prairies	annual, five year trends
Weed Score	quadrat, transect	annual, five year trends
Species richness (N and S)	quadrat, community	annual, five year trends
Species Cover	quadrat, community	annual, five year trends

Table 9. Summary of FQI indices for the American Camp Prairies[a].

Sample	Number of Quadrats	Species Richness[c]		FQI_N	FQI_S	CC_N	CC_S	Weed Score
		Average Native	Average Exotic					
Entire prairie	106	3.8 (2.9)	8.3 (3.7)	7.15	4.28	3.68	1.33	-2.27
Exotic[b]	57	2.1 (1.8)	8.0 (3.5)	4.83	2.49	3.11	0.85	-2.30
Native[b]	49	5.8 (2.8)	8.6 (4.1)	15.6	10.8	4.34	1.89	-3.20
Abronia latifolia[c]	10	2.0 (1.4)	2.7 (2.5)	7.65	5.57	5.63	3.33	-2.09
Agrostis capillaris	11	1.9 (1.6)	9.6 (2.2)	3.29	1.79	2.48	0.51	-2.14
Agrostis stolonifera	3	0.3 (0.6)	4.3 (2.5)	2.0	0.71	2.0	0.25	-2.43
Bromus sitchensis	12	3.6 (2.9)	11.3 (2.4)	7.63	3.76	4.48	0.94	-2.23
Cakile maritima	4	0.5 (0.6)	1.3 (0.5)	2.5	1.64	2.5	1.08	-2.13
Elymus repens	5	1.2 (0.8)	7.0 (1.9)	2.76	1.2	2.3	0.42	-2.4
Festuca roemerii	15	8 (2.1)	10.8 (2.6)	12.6	8.19	4.51	1.89	-2.03
Holcus lanatus	21	4.6 (2.5)	9.8 (2.9)	7.7	4.6	3.47	1.22	-2.44
Juncus balticus	4	5.2 (4.1)	2.2 (1.0)	7.34	5.76	2.82	1.73	-2.58
Leymus mollis	7	4.1(1.9)	9.4 (2.0)	7.22	3.93	3.78	1.07	-2.33
Lupinus littoralis	10	3.6 (1.4)	8.0 (2.7)	6.47	3.69	3.38	1.09	-2.29
Poa pratensis	4	3.0 (2.2)	6.8 (2.2)	5.74	3.25	3.29	1.0	-2.55

[a] Indices were calculated from data and collected during the SAJH vascular plant inventory and community types were described in the report from that study (Rochefort and Bivin 2010)

[b] Average # per quadrat (standard deviation)

[c] Quadrats with <50% native cover were classified as Exotic and quadrats with ≥50% native cover were classified as native

I. Reporting and Product Development

Annual and five-year detailed summary reports will be produced throughout the life of the monitoring project.

Annual Reports

Annual reports will be issued every year after field data collection. The first Annual Report would be issued after year 1 of the program, but would contain only data summaries for transects and each unit because change detection is not possible after 1 year. These reports will contain routine data summaries and can include trends analysis beginning in year 3 (see **Appendix E: Template for Prairie Vegetation Monitoring Annual Report**). Annual reports will:

- Summarize distribution of cover types within each unit
- Summarize proportions of transect areas dominated by exotic and native species within each physiognomic cover type
- Provide summaries by transect and averages for each unit
- Provide summaries of quadrat data in several terms: FQI, Weed Scores, average cover and frequency by species
- Report data in a scorecard format to clearly and concisely relay ecological integrity to a wide audience
- Be used to update Resource Briefs as ecological conditions change

Five-Year Reports

Once every 5 years a report will be issued that contains routine data summaries and statistical analyses to detect unit-wide long-term trends and estimate unit-wide status. The first 5-year report will be issued after 5 years of data collection. The initial five-year report will provide a review of the FQI, Weed Scores, and quadrat data analysis and recommendations for future annual and five-year reports.

Refer to **SOP 13: Product Delivery, Posting and Distribution** for the complete schedule for project reports and other deliverables and the people responsible for them and **Appendix E: Template for Prairie Vegetation Monitoring Annual Report**.

Standard Report Format

Annual reports and trend analysis reports will use the NPS Natural Resource Publications template, a pre-formatted Microsoft Word template document based on current NPS formatting standards. Annual reports will use the Natural Resource Technical Report (NRTR) template, and trend analysis and other peer-reviewed technical reports will use the Natural Resource Report (NRR) template. These templates and documentation of the NPS publication standards are available at: http://www.nature.nps.gov/publications/NRPM/index.cfm.

Review Products for Sensitive Information

Before preparing data in any format for sharing outside NPS – including presentations, reports, and publications – the Project Lead should refer to the guidance in the next section and in **SOP 14: Sensitive Information Procedures**. Certain information that may convey specific locations of sensitive resources may need to be screened or redacted from public versions of products prior to release.

J. Identifying and Handling Sensitive Information

Certain project information related to the specific locations of rare or threatened taxa may meet criteria for protection and as such should not be shared outside NPS except where a written confidentiality agreement is in place prior to sharing. Before preparing data in any format for sharing outside NPS – including presentations, reports, and publications – the Project Lead should consider whether or not the resulting information might put protected resources at risk. Information that may convey specific locations of sensitive resources may need to be screened or redacted from public versions of products prior to release.

Although it is the general NPS policy to share information widely, the NPS also realizes that providing information about the location of park resources may sometimes place those resources at risk of harm, theft, or destruction. This can occur, for example, with regard to caves, archeological sites, tribal information, and rare plant and animal species. Therefore, information will be withheld when the NPS foresees that disclosure would be harmful to an interest protected by an exemption under the Freedom of Information Act (FOIA). The National Parks Omnibus Management Act, Section 207, 16 U.S.C. 5937, is interpreted to prohibit the release of information regarding the "nature or specific location" of certain cultural and natural resources in the national park system. Additional details and information about the legal basis for this policy are in the NPS Management Policies (National Park Service 2006) and in Director's Order 66 (available at: http://home.nps.gov/applications/npspolicy/DOrders.cfm).

These guidelines apply to all NCCN staff, cooperators, contractors, and other partners who are likely to acquire or otherwise have access to information about protected NPS resources. The Project Lead has primary responsibility for ensuring adequate protection of sensitive information related to this project.

The following are highlights of our strategy for protecting this information:

- *Protected resources*, in the context of the NCCN Inventory and Monitoring Program, include species that have State- or Federally-listed status, and other species deemed rare or sensitive by local park taxa experts.
- *Sensitive information* is defined as information about protected resources that may reveal the "nature or specific location" of protected resources. Such information must not be shared outside the National Park Service, unless a signed confidentiality agreement is in place.
- In general, if information is withheld from one requesting party, it must be withheld from anyone else who requests it, and if information is provided to one requesting party without a confidentiality agreement, it must be provided to anyone else who requests it.
- To share information as broadly as legally possible, and to provide a consistent, tractable approach for handling sensitive information, the following shall apply if a project is likely to collect and store sensitive information:
    - Random coordinate offsets of up to 2 km for data collection locations, and
    - Removal of data fields likely to contain sensitive information from released data set copies.

Additional details for identifying, handling and protecting sensitive information are described in **SOP 14: Sensitive Information Procedures**.

K. Product Delivery, Posting and Distribution

Refer to **SOP 13: Product Delivery, Posting and Distribution** for the complete schedule for project deliverables and instructions for packaging and delivering them. Upon delivery, products will be posted to NPS websites and clearinghouses (e.g., IRMA, NPSpecies, NPS Data Store) as appropriate.

Holding Period for Project Data

To permit sufficient time for priority in publication, certified project data will be held upon delivery for a period not to exceed two years after data certification. After the two-year period has elapsed, all certified, non-sensitive data will be posted to the NPS Data Store. Note: This hold only applies to raw data, and not to metadata, reports or other products which are posted to NPS clearinghouses immediately after being received and processed.

Special Procedures for Sensitive Information

Products that have been identified upon delivery by the Project Lead as containing sensitive information will normally be revised into a form that does not disclose the locations of protected resources – most often by removing specific coordinates and only providing coordinates that include a random offset to indicate the general locality of the occurrence. If this kind of measure is not a sufficient safeguard given the nature of the product or the protected resource in question, the product(s) will be withheld from posting and distribution.

If requests for distribution of products containing sensitive information are initiated by the NPS, by another federal agency, or by another partner organization (e.g., a research scientist at a university), the unedited product (i.e., the full data set that includes sensitive information) may be shared only after a confidentiality agreement has been established between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared. Refer to **Section 4J, Identifying and Handling Sensitive Information** for more information.

L. Archiving and Records Management

All project files should be reviewed and organized by the Project Lead on a regular basis (e.g., annually in January). Unneeded draft documents and other intermediate files should be deleted to conserve space and maintain a clear and unambiguous record for future project staff. See **SOP 1: Project Workspace and Records Management** for more details. Decisions on what to retain and what to destroy should be made following guidelines stipulated in NPS Director's Order 19 (available at: http://home.nps.gov/applications/npspolicy/DOrders.cfm), which provides a schedule indicating the amount of time that the various kinds of records should be retained.

Because this is a long-term monitoring project, good records management practices are critical for ensuring the continuity of project information. Files will be more useful to others if they are well organized, well named, and stored in a common format. Details for handling project files are described in **SOP 1: Project Workspace and Records Management**. In addition, files containing sensitive information must be stored in a manner that will enable quick identification. Refer to **Section 4J, Identifying and Handling Sensitive Information**.

M. Season Close-out

After the conclusion of the field season, the Project Lead, Data Manager, and GIS Specialist should meet to discuss the recent field season, and to document any needed changes to the field

sampling protocols, to the database structure or front-end application, or to any of the SOPs associated with the protocol.

5. Personnel Requirements and Training

A. Roles and Responsibilities

The roles associated with this Protocol are Project Lead, Park Resource Chief, Statistician, Field Crew Lead, Field Technician, Data Manager, GIS Specialist, Network Program Manager, and Park Curator. One person may take on several roles. Specific responsibilities associated with the roles are found in Table 10, and the information management task list associated with these roles and responsibilities are found in **Appendix C. Yearly Project Task List**.

Table 10. Roles and responsibilities for Prairie Vegetation Monitoring in the NCCN.

Role	Responsibilities	Position (Name)
Project Lead	• Project administration, operations, and implementation • Track project objectives, budget, requirements, and progress toward meeting objectives • Coordinate and ratify changes to protocol • Lead training of field crews • Maintain and archive project records • Certify each season's data for quality and completeness • Conduct data summaries and analysis, complete reports, metadata, and other products according to schedule	NOCA Plant Ecologist (Mignonne Bivin)
Park Resource Chief	• Facilitate logistics planning and coordination • Review reports, data and other project deliverables • Assist with training and ensuring safety of field crew • Insure compliance is up-to-date	SAJH Chief of Integrated Resources (Jerald Weaver)
Field Crew Lead	• Assist in training and ensuring safety of field crew • Acquire and maintain field equipment • Plan and execute field visits • Oversee data collection and entry, verify accurate data transcription into database • Complete a field season report	Seasonal technician (GS-7)
Technicians	• Collect, record, enter and verify data	Seasonal technicians (GS-5), volunteers and interns
Data Manager	• Consult on data management activities • Facilitate check-in, review and posting of data, metadata, reports, and other products to national databases and clearinghouses according to schedule • Maintain and update database application • Provide database training as needed • Coordinate with GIS Specialist on upload of GPS coordinate data to database	NCCN Data Manager (John Boetsch)
GIS Specialist	• Consultant on spatial data collection, GPS use, and spatial analysis techniques • Facilitate spatial data development and map output generation • Work with Project Lead and Statistician to analyze spatial data and develop metadata for spatial data products • Primary steward of GIS data and products • Prepare GPS units for field season, provide training to Field Lead and crew	NCCN GIS Specialist
Network Program Manager	• Review annual reports for completeness and compliance with I&M standards and expectations	NCCN Program Manager (Mark Huff)

Table 10. Roles and responsibilities for Prairie Vegetation Monitoring in the NCCN (continued).

Role	Responsibilities	Position (Name)
Park Curator	• Receive and archive copies of annual reports, analysis reports, and other publications • Facilitate archival of other project records (e.g., original field forms, etc.) • Accession plant specimens into herbarium at NOCA	Park Curator and Collections Manager at NOCA (Kelly Cahill)
Statistician	• Consultant on technical issues related to project sampling design, statistical analyses, or other issues related to changes in protocol	Determined as needed

B. Qualifications

The Field Lead each year should have experience with plant identification, preferably in plants of the Pacific Northwest. The ability to identify and key grasses and sedges is also helpful. Familiarity with SAJH is desirable. Ideally, the Field Lead will have supervised field crews before and/or previously served as a crew member for an NCCN vegetation monitoring project. Finally s/he must be physically fit and prepared to spend extended periods of time in the field, although backcountry travel will not be a component of this protocol.

The field crew members should have prior botany experience, including substantial experience with the Pacific Northwest flora or with demonstrated ability to quickly learn plant identification. They must also be physically fit and prepared to spend extended periods of time in the field.

C. Training Procedures

Training will be accomplished during the first week of the field season and should be planned to allow for ample time for any required meetings between the Field Crew, Field Lead, Project Lead, Data Manager and GIS Specialist. The following general topics will be covered (See **SOP 3: Orientation and Training of Field Crews** for details):

- Background on project objectives, sampling design, and data analysis
- Safety – including vehicle safety, equipment safety, conducting field work safely, etc.
- Orienteering, and specifically: use of GPS (traversing prairie transects to map cover type changes and navigating to vegetation plots), compass, and laser range finder
- Plant identification-including a review of dichotomous keys, common plants found in the prairies, when and how to collect voucher specimens
- Establishing and sampling vegetation plots and methods for plot marking of plot locations.
- Training in the plant cover estimation
- Sensitive species found in the prairie and procedures when encountered.
- Office procedures – administrative procedures, data entry and QA/QC, IT security, voucher processing, handling and scanning of data forms, downloading GPS data, etc.

Training will have both office and field components. The office component will include presentations and hands-on experience in GPS use and data downloading as well as entry of field data into the database. The field component will include exercises in navigating and collecting data with a GPS, field plant identification and establishing and sampling a vegetation plot.

6. Operational Requirements

A. Annual Workload and Field Schedule

A detailed schedule for project activities is found in **Appendix C: Yearly Project Task List**. In brief, SAJH will hire field crew members by March 15. The crew will consist of a Field Crew Lead and one crew member who will conduct data collection, data entry, and complete field season reports in addition to other responsibilities for SAJH. Currently, SAJH has one term GS-07 Field Lead and a GS-05 seasonal Biological Technician; I&M funds tasks will be used to lengthen the appointments of these employees. In preparation for the field season, new or replacement equipment orders will be placed in January each year, and the computer workspace and database set-up will be completed by April 15. Field crew training will occur during the last two weeks of May, with field work conducted for the rest of the field season. Following the field season, the Project Lead and other NPS staff members will evaluate the protocol and assess whether changes are needed. The Project Lead is responsible for data certification by the beginning of November so that the Data Manager can upload the data by the end of November, and complete metadata by the end of January. Data will be analyzed and a report generated by the Project Lead during February to March, to be delivered to the NCCN Program Manager by March 31. The project will require help from GIS staff for GPS unit setup, GPS training, downloading of GPS data during the field season, and generating occasional map output.

B. Facility and Equipment Needs

This project requires a moderate amount of special facilities and equipment. The crew will be based at SAJH so no additional housing will be needed. The Project Lead and GIS Specialist will require travel funds and housing in the vicinity for initial training and the Project Lead may need to travel to work with the Chief of Resources for project planning or review. The NCCN owns GPS equipment and associated software and a range finder; they may need periodic replacement. The park will have to supply computers for data entry and review. Equipment requirements for each task in the protocol are listed as appropriate in the SOPs.

C. Startup Costs and Budget Considerations

This project has relatively low start-up costs because most equipment needs have already been paid for in the pilot stage of protocol development. However, periodically there will be some replacement as equipment is damaged or wears out, amounting to $500 to $3,500 (i.e. range finders or GPS equipment).

Annual costs of fieldwork (specifically travel) will be significantly reduced by utilizing field crews based at SAJH (Table 11). Costs for permanent personnel (i.e. Project Lead, Data Manager, GIS Specialist, and SAJH Chief of Resources) at English Camp are calculated as additional time to the time needed for American Camp. However, we anticipate that during the first 3-5 years, additional pilot studies will be necessary to refine vegetation composition field and analysis methods and to apply the Coefficient of Conservatism to park management. Specifically, the NCCN Plant Ecologists, Science Advisor, and SAJH Resource Chief should work with the Project Lead to finalize quadrat data collection and analysis methods.

Table 11. Prairie monitoring protocol projected budget for implementation at SAJH.

Project Stage / Budget Category	Personnel	Grade	American Camp		English Camp	
			Pay Periods	Cost based on FY2010 $s	Pay Periods	Cost based on FY2010 $s
Preparation	Project Lead	GS-12	0.3	1,200	0.2	800
	Chief of Resources SAJH[1]	GS-11	0.3	976	0.2	651
	Data Manager	GS-11	0.4	1,360	0.1	340
	GIS Specialist	GS-9	0.3	900	0.1	300
Data Acquisition	Project Lead	GS-12	0.2	800	0.1	400
	Chief of Resources SAJH[1]	GS-11	0.2	651	0.1	325
	Data Manager	GS-11	0.1	340	0.1	340
	Field Crew Lead	GS-7	2.5	4,833	1.5	2,900
	Field Technician	GS-5	2.5	3,229	1.5	1,938
Data Entry, Processing, & Quality Review	Project Lead	GS-12	0.1	400	0.1	400
	Chief of Resources SAJH[1]	GS-11	0.3	976	0.1	325
	Data Manager	GS-11	0.4	1,360	0.1	340
	Field Crew Lead	GS-7	0.5	967	0.2	387
	Field Technician	GS-5	0.5	646	0.2	258
	GIS Specialist	GS-9	0.1	300	0.1	300
Data Certification & Documentation	Project Lead	GS-12	0.6	2,400	0.2	800
	Data Manager	GS-11	0.4	1,360	0.2	680
	GIS Specialist	GS-9	0.1	300	0.1	300
Data Analysis	Project Lead	GS-12	1.0	4,000	0.1	400
	Data Manager	GS-11	0.2	680	0.1	340
	GIS Specialist	GS-9	0.1	300	0.1	300
Reporting & Product Development	Project Lead	GS-12	0.5	2,000	0.2	800
	Chief of Resources SAJH[1]	GS-11	0.5	1,627	0.2	651
	Data Manager	GS-11	0.3	1,020	0.1	340
	NCCN Program Manager	GS-13	0.1	500	0.1	500
	GIS Specialist	GS-9	0.1	300	0.1	300
Archiving, Posting & Records Management	Project Lead	GS-12	0.2	800	0.1	400
	Data Manager	GS-11	0.3	1,020	0.1	340
Season Close-out	Project Lead	GS-12	0.2	800	0.1	400
	Chief of Resources SAJH[1]	GS-11	0.2	651	0.1	325
	Field Crew Lead	GS-7	0.2	387	0.1	194
	Data manager	GS-11	0.2	680	0.1	340
	GIS Specialist	GS-9	0.1	300	0.1	300
Total Personnel				38,129		15,437
Contributed Personnel				4,800		2,277
Travel				$600		$400
Vehicles				$250		$200
Supplies				$200		$200
Total[2]				34,299		$16,237

[1]In-kind support from SAJH

[2]Total excluding contributed personnel costs

Literature Cited

Agee, J. K. 1984. Historic landscapes of San Juan Island National Historical Park. National Park Service Report CPSU UW 84-2, Cooperative Park Unit, College of Forest Resources, University of Washington, Seattle, WA.

Agee, J. K. 1987. The forests of San Juan Island National Historical Park. National Park Service Technical Report CPSU/UW 88-1, Pacific Northwest Region. Seattle, WA.

Agee, J. K. 1993. Fire Ecology of Pacific Northwest Forests. Island Press. Washington, D.C.

Avery, C. 2004. San Juan Island National Historical Park: an environmental history. National Park Service, Pacific West Regional Office, Seattle WA.

Boetsch, J. R., B. Christoe, and R. E. Holmes. 2009. Data management plan for the North Coast and Cascades Network Inventory and Monitoring Program (2005). Natural Resource Report NPS/NCCN/NRR—2009/078. National Park Service, Fort Collins, CO.

Booth, D. B. 1994. Glaciofluvial infilling and scour of the Puget Lowland, Washington, during ice-sheet glaciation. Geology 22:695-698.

Bowers, K. and C. Boutin. 2008. Evaluating the relationship between floristic quality and measures of plant biodiversity along stream bank habitats. Ecological Indicators 8:466-475.

Breidt, F. J. and W. A. Fuller. 1999. Design of supplemented panel surveys with application to the natural resources inventory. Journal of Agricultural, Biological, and Environmental Statistics 4(4):331-345.

Butler, S. A. and L. L. McDonald. 1983. Unbiased systematic sampling plans for line intercept methods. Journal of Range Management 36(4): 463-468.

Chappell, C., M. S. Gee, B. Stephens, R. C. Crawford and S. Farone. 2001. Distribution and decline of native grasslands and oak woodlands in the Puget lowland and Willamette valley ecoregions, Washington. Pages 124-139 *in* S. H. Reichard, P. W. Dunwiddie, J. G. Gamon, A. R. Kruckeberg and D. L. Salstrom, (eds.). Conservation of Washington's Rare Plants and Ecosystems. Washington Native Plant Society, Seattle, WA.

Chappell, C. B., M. S. Gee, and B. Stephens. 2003. A geographic information system map of existing grasslands and oak woodlands in the Puget lowland and Willamette valley ecoregions, Washington. Unpublished report. Washington Natural Heritage Program, Washington Department of Natural Resources, Olympia, WA.

Crawford, R. C. and H. Hall. 1997. Changes in the south Puget Sound prairie landscape. Pages 11-15 *in* Ecology and Conservation of the South Puget Sound Prairie Landscape. P. Dunn. and K. Ewing, (eds.). 1997. The Nature Conservancy, Seattle, WA.

Davis, G. E. 1989. Design of a long-term ecological monitoring program for Channel Islands National Park. Natural Areas Journal 9:80-89.

Davis, G. E. 2005. National Park stewardship and 'vital signs' monitoring: a case study from Channel Islands National Park, California. Aquatic Conservation: Marine and Freshwater Ecosystems 15:71-89.

DeKeyser, E. S., E. R. Kirby, and M. J. Ell. 2003. An index of plant community integrity: development of the methodology for assessing prairie wetland plant communities. Ecological Indicators 3: 119-133.

Diaz-Ramos, S., D. L. Stevens, and A. R. Olsen. 1996. EMAP statistical methods manual. Report EPA/620/R-96/002. U.S. Environmental Protection Agency, Office of Research and Development, National Health and Environmental Effects Research Laboratory, Corvallis, OR.

Dunn, P., and K. Ewing, (eds.). 1997. Ecology and conservation of the South Puget Sound prairie landscape. The Nature Conservancy of Washington, Seattle, WA.

Dunwiddie, P., E. Alverson, A. Stanley, R. Gilbert, S. Pearson, D. Hays, J. Arnett, E. Delvin, D. Grosboll, C. Marschner. 2006. The vascular plant flora of the South Puget Sound prairies, Washington, USA. Davidsonia 14(2):51-69.

Fancy, S. G., J. E. Gross, and S. L. Carter. 2009. Monitoring the condition of natural resources in US National Parks. Environmental Monitoring and Assessment 151:161-174.

Foster, J. R. and S. E. Shaff. 2003. Forest colonization of Puget lowland grasslands at Fort Lewis, Washington. Northwest Science 77:283-296.

Franklin, J. F., and C. T. Dyrness. 1988. Natural vegetation of Oregon and Washington. Oregon State University Press, Corvallis, OR.

Fuller, W. A. 1999. Environmental surveys over time. Journal of Agricultural, Biological, and Environmental Statistics 4(4):391-403.

Jog, S., K. Kindscher, E. Questad, B. Foster, and H. Loring. 2006. Floristic quality as in indicator of native species diversity in managed grasslands. Natural Areas Journal 26(2): 149-167.

Klips, R. A. 2004. Using newly developed analytical tools to compare a restored prairie with a remnant in Ohio. Ecological Restoration 22(2): 99-105.

Kruckeberg, A. R. 1991. The Natural History of Puget Sound. University of Washington Press, Seattle, WA.

Lambert, A. M. 2006. Prairie restoration in American Camp, San Juan Island National Historical Park: fire and herbicide effects on community composition and growth and survival of planted native species. M.S. Thesis, University of Washington, Seattle, WA.

Lambert, A. M. 2009. Island marble butterfly survey at American Camp, San Juan Island National Historical Park, 2008 field survey report. Unpublished report to the National Park Service. University of Washington, Seattle, WA.

Lopez, R. D. and M. S. Fennessy. 2002. Testing the floristic quality assessment index as an indicator of wetland condition. Ecological Applications 12: 487-497.

Manly, B. F. J. 1997. Randomization, Bootstrap and Monte Carlo Methods in Biology, 2nd ed. Chapman and Hall, London.

McCoy, A., and C. Dalby. 2009. Prairie monitoring protocol development: North Coast and Cascades Network: U.S. Geological Survey Open-File Report 2008-1168.

McDonald, T. L. 2003. Review of environmental monitoring methods: survey designs. Environmental Monitoring and Assessment 85:277-292.

National Park Service. 2001. Park Vital Signs Monitoring – A commitment to resource protection. National Park Service, National Resource Program Center, Fort Collins, CO.

National Park Service. 2005. San Juan Island National Historical Park fire management plan – environmental assessment. San Juan island National Historical Park, Friday Harbor, WA.

National Park Service. 2006. Management Policies. Available at: http://www.nps.gov/policy/mp/policies.html (accessed 6 February 2007).

National Park Service. 2008. San Juan Island National Historical Park Final General Management Plan and Environmental Impact Statement. National Park Service, Pacific West Region, Seattle, WA.

North Coast and Cascades Network (NCCN). 2007. Metadata development guidelines. USDI National Park Service. Available at: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm.

North Coast and Cascades Network (NCCN). 2009. GPS data acquisition and processing. U.S. Department of Interior, National Park Service. Available at: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm.

Oakley, K. L, L. P. Thomas, and S. G. Fancy. 2003. Guidelines for long-term monitoring protocols. Wildlife Society Bulletin 31:1000-1003.

Pater, D. E., S.A. Bryce, T. D. Thorson, J. Kagan, C. Chappell, J. M. Omernik, S. H. Azevedo, and A. J. Woods. 1998. Ecoregions of western Washington and Oregon (2 sided color poster with map, descriptive text, summary tables, and photographs). U.S. Geological Survey, Reston, Virginia. Scale 1:1,350,000.

Peterson, D. L. and R. D. Hammer. 2001. From open to closed canopy: a century of change in a Douglas-fir closed canopy forest, Orcas Island, Washington. Northwest Science 75:262-279.

Piepho, H. P. and J. O. Ogutu. 2002. A simple mixed model for trend analysis in wildlife populations. Journal of Agricultural, Biological and Environmental Statistics 7:350-360.

Pojar, J. and A. MacKinnon. (eds.). 1994. Plants of the Pacific Northwest coast. Lone Pine Publishing, Vancouver, B.C., Canada.

Rochefort, R. M. and M. M. Bivin. 2010. Vascular plant inventory of San Juan Island National Historical Park Natural Resource Technical Report NPS/NCCN/NRTR—2010/350. National Park Service, Fort Collins, CO.

Rooney, T. P. and D. A. Rooney. 2002. The modified floristic quality index. Natural Areas Journal 22(4): 340-344.

Rolph, D. N. and J. K. Agee. 1993. A vegetation management plan for the San Juan Island National Historical Park. Technical Report NPS/PNRUW/NRTR-93/02. National Park Service, Seattle, WA.

Sheehan, M. 2007. Prairie and oak woodland habitats and associated rare species on Whidbey Island. Unpublished report for Whidbey Land Trust. Greenbank, WA.

Sprenger, S. M. 2008. Soil microsite conditions of *Festuca roemeri* and *Castilleja levisecta* in native prairies of western Washington. M.S. Thesis, University of Washington, Seattle, WA.

Stevens, D. L. and A. R. Olsen. 2003. Variance estimation for spatially balanced samples of environmental resources. Environmetrics 14:593-610.

Stevens, D. L. and A. R. Olsen. 2004. Spatially balanced sampling of natural resources. Journal of the American Statistical Association 99:262-278.

Swink, F. and G. Wilhelm. 1979. Plants of the Chicago region. Revised and expanded edition with keys. The Morton Arboretum, Lisle, IL.

Taft, J. B., G. S. Wilhelm, D. M. Ladd, and L. A. Masters. 1997. Floristic quality assessment for vegetation in Illinois, a method for assess vegetation integrity. Erigenia 15:3-95.

Taft, J. B., C. Hauser, K. R. Robertson. 2006. Estimating floristic integrity in tallgrass prairie. Biological Conservation 131:42-51.

Thompson, S. K. 1992. Sampling. John Wiley and Sons, New York, NY.

Tierney, G. L., D. Faber-Langendoen, B. R. Mitchell, W. G. Shriver, and J. P. Gibbs. 2009. Monitoring and evaluating the ecological integrity of forest ecosystems. Frontiers in Ecology and the Environment 7(6):308-316.

Ugolini, F. C., and A. K. Schlichte. 1973. The effect of Holocene environmental changes on selected western Washington soils. Soil Science 116:218-227.

United States Department of Agriculture, Natural Resources Conservation Service, and United States Department of the Interior, National Park Service. 2005. Soil survey of San Juan Island National Historical Park, WA.

Urquhart, N. S., S. G. Paulsen, and D. P. Larsen. 1998. Monitoring for policy-relevant regional trends over time. Ecological Applications 8(2):246-257

Venables, W. N. and B. D. Ripley. 1999. Modern applied statistics with S-Plus, 3rd ed. Springer, New York, NY.

Wand, M. P. and M. C. Jones. 1995. Kernel smoothing. Chapman and Hall, London.

Weber, S., A. Woodward, and J. Freilich. 2009. North Coast and Cascades Network vital signs monitoring report (2005). Natural Resource Report NPS/NCCN/NRR—2009/098. National Park Service, Fort Collins, CO.

Weiser, A. L. 2006. Exploring 10,000 years of human history on Ebey's Prairie, Whidbey Island, Washington. M.A. Thesis, Simon Fraser University, Burnaby, B.C., Canada.

Whitlock, C. 1992. Vegetational and climatic history of the Pacific Northwest during the last 20,000 years: Implications for understanding present-day biodiversity. The Northwest Environmental Journal 8:5-28.

SOP 1: Project Workspace and Records Management

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP describes how and where project files and records are managed by project staff. Workspace structure, naming conventions, and procedures for handling project files are included.

NCCN File Workspace

NCCN has a centralized file system and project workspaces available for use by field crews and project staff at: \\inpolymfs\parkwide\NCCN. This will help avoid the problem of NCCN projects having several versions of files on different servers around the network. These folders are set up so that park and network staff members at the network parks all have read privileges throughout the directory structure. Project leads and a few other individuals associated with each project have full privileges for their project folder so they can manage their own permissions. These workspaces are intended to be a more familiar and convenient way of storing information, as an adjunct to the NCCN SharePoint site. Apart from reports and protocols (which are to be maintained in the NCCN Digital Library (a section of the NCCN SharePoint site), project leads will decide what is to be stored locally in these project workspaces as opposed to on the team SharePoint site. Examples of files kept in these project workspaces include: working files for project field crews, GPS downloads, GIS map files, database files, and other project records.

The NCCN file workspace is organized as follows under four main folders: Libraries, Projects, Temp, and Workspace. Project staff members will primarily be working in one or more of the project folders under Projects, and may wish to make desktop shortcuts to one or more of the project subfolders by right-clicking on the desired folder and selecting Send To > Desktop (create shortcut).

Project staff members should create a network shortcut to the project workspace by going to the Desktop in Windows Explorer and adding a new network place under My Network Places. Project staff located at OLYM will typically already have this path available to them via a mapped drive (e.g., the I:\ drive); however, they should still create this network shortcut where multiple parks are concerned for the sake of communications and consistency among parks. Performance is the main rationale for using network shortcuts instead of mapped drives at other parks.

Instructions for creating a network shortcut to the NCCN workspace:

1. Open an instance of Windows Explorer. One way is from the Start menu, go to: All Programs > Accessories > Windows Explorer. Another is to open My Documents, My Computer, or any other folder browser shortcut.
2. Navigate to the Desktop, and then to My Network Places.
3. Double-click the Add Network Place option to open the setup wizard.
4. Choose the option to specify the network location, then under network address, type in: \\inpolymfs\parkwide\NCCN
5. When prompted for a name for the network place, enter "NCCN" (or something similarly brief and meaningful).
6. This network place shortcut should now be available each time you log in to that particular computer, and can be accessed when navigating within most Windows software.

Project Workspace

A section of the NCCN workspace is reserved for this project. The recommended file structure within this workspace is shown in Figure 1.1.

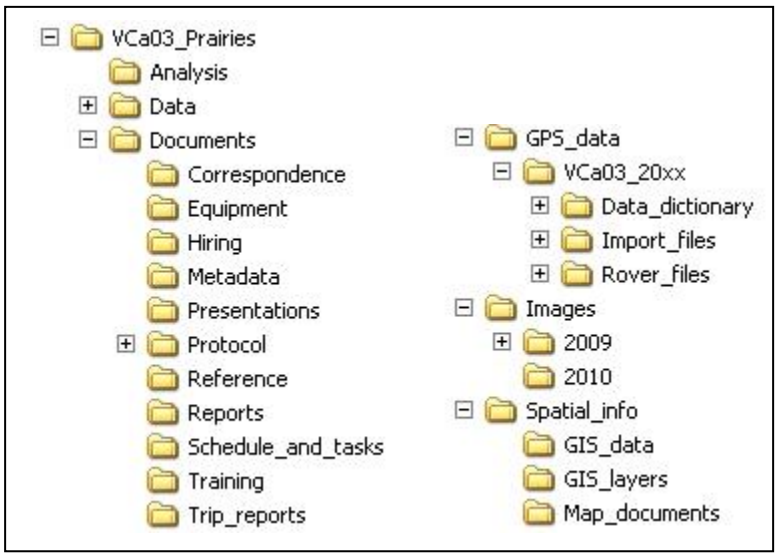


Figure 1.1. Recommended file structure for project workspace. Note: The workspace folder name includes 'VCa03', the NCCN project code.

Each major subfolder is described as follows:

- Analysis – Contains working files associated with data analysis.

- Data – Contains the front-end database application file for the season. The back-end database for the project is maintained in Microsoft SQL Server. Database exports and other intermediate summary information can be stored here as well; these files are most effectively managed within subfolders named by calendar year.

- Documents – Contains subfolders to categorize documents as needed for various stages of project implementation. Additional folders and subfolders may be created as needed to arrange information in a way that is useful to project staff.

- GPS data – Contains GPS data dictionaries, and raw and processed GPS data files. This folder contains subfolders to arrange files by year. Each of these subfolders also contains the project code to make it easier to select the correct project folder within the GPS processing software.

- Images – For storing images associated with the project. This folder has subfolders named by calendar year to make it easier to identify and move files to the project archives at the end of each season. Refer to **SOP 9: Managing Photographic Images** for more details.

- Spatial info – Contains files related to visualizing and interacting with GIS data.
    - GIS data – New working shapefiles and coverages specific to the project.
    - GIS layers – Pointer files to centralized GIS base themes and coverages.
    - Map documents – Map composition files (.mxd).

Seasonal Workspace

In addition to these permanent folders, a temporary seasonal workspace is established at the beginning of each field season (e.g., "2011_field_crew"). This temporary workspace provides a place for field crew members to create and modify files while limiting access privileges for the remainder of the project workspace. Subfolders are created for Images and GPS data to allow field crew members to process incoming files as needed. Temporary workspaces may also be established on other servers to provide local access to crews stationed at other parks. At the end of the season, files in these temporary workspaces are then filed in the appropriate permanent folder(s).

Folder Naming Standards

In all cases, folder names should follow these guidelines:

- No spaces or special characters in the folder name.
- Use the underbar ("_") character to separate words in folder names.
- Try to limit folder names to 20 characters or fewer.
- Dates should be formatted as YYYYMMDD (this leads to better sorting than other date naming conventions).

File Naming Standards

Unless otherwise specified, file names should follow these guidelines:

- No spaces or special characters in the file name.
- Use the underbar ("_") character to separate file name components.
- Try to limit file names to 30 characters or fewer, up to a maximum of 50 characters.
- Dates should be formatted as YYYYMMDD.
- Correspondence files should be named as YYYYMMDD_AuthorName_subject.ext.

Workspace Maintenance Procedures

Prior to each season, the Project Lead should:

1. Make sure that network accounts are established for each new staff member, or reactivated for returning staff members. By default, the IT staff puts new user accounts into a group that has read-only access to all files.
2. Create new folders named by year under the Images and GPS data sections.
3. Create the seasonal workspace, with subfolders for Images and GPS data.
4. Add user logins for the seasonal crew members to the seasonal workspace, with modify privileges. This can be done by right-clicking on the seasonal workspace folder, selecting Properties > Security, then adding users one at a time and checking the box in the Allow column for Modify privileges.
5. Provide the Data Manager with a list of user logins that need access to the database.

After each season, the Project Lead should:

1. Review the workspace organization and clean up any temporary files and subfolders that are no longer needed.
2. Move files from the seasonal workspace folders into the appropriate permanent folder(s) and archive or delete the seasonal workspace folders as desired. See **SOP 9: Managing Photographic Images** for specific instructions for images.
3. Compare older files against the retention schedule in NPS Director's Order 19 (available at: http://home.nps.gov/applications/npspolicy/DOrders.cfm). Dispose of files that are beyond their retention schedule if they are no longer needed. As a long-term project, many files associated with this project are likely to be scheduled for permanent retention. This makes it all the more imperative to clean out unneeded files before they accumulate and make it harder to distinguish the truly useful and meaningful ones.
4. Convert older files to current standard formats as needed to maintain their usefulness.
5. Identify files that may contain sensitive information (as defined in **Section 4J, Identifying and Handling Sensitive Information**). Such files should be named and filed in a way that will allow quick and clear identification as sensitive by others.
6. Post final documents and files to the NCCN Digital Library for long-term storage. See **SOP 13: Product Delivery, Posting and Distribution**.
7. Send analog (non-digital) materials to the park collections for archiving.

SOP 2: Preparing for the Field Season

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP provides instructions for preparations prior to the field season. This SOP encompasses season scheduling and travel planning, assessing and ordering equipment and supplies, and assembling packets of maps, directions, and data forms for plot measurements. This work begins in late fall after certification of the previous year's data and continues through the start of the field season in May.

Scheduling and Coordinating with Personnel

1. Update the season schedule (located in the project workspace within the folder Documents\Schedule_and_tasks\), including a list of transects and vegetation plots to be visited. When planning field tours keep in mind the time required for the components of field tours listed below. Once transects and plots have been visited, the logistics information recorded on the Event Log will help refine time estimates. Consider the following:
    a. Ferry schedules (to and from the island), travel time to the ferry, transport times, if reservations are needed for the Project Lead
    b. Travel from the office to the field sites.
    c. Hiking to and from transects and plots each day
    d. Approximate time to complete transects and quadrats
    e. A full office day or more at the end of each tour is essential to the acquisition of quality data. The crews need time to download photos, GPS points, maintain equipment, identify plants and enter data while it is still fresh in their minds.
2. The Project Lead will work with the GIS Specialist to create a map for each camp with transect and plot locations to be visited that year.
3. Send copies of the schedule and map to:
    a. San Juan Chief of Resources
    b. Field Crew Lead
4. The Project Lead will work with the SAJH Chief of Resources to arrange and confirm scheduled orientation and field training dates with the field crew and GIS Specialist.

Ordering Supplies

At the end of the field season, project equipment and supplies should be inventoried by the Project Lead and Field Crew Lead (Table 2.1). During the off-season, the Project Lead should use this information, to determine which items to order. Restock the first-aid kits using the check list (Table 2.2), and consider what safety supplies may be needed in vehicles. Contact information for companies and stores that have stocked equipment is located in the folder Documents\Equipment\Purchasing in the project workspace. Label all new supplies with "NCCN Prairie Veg." Number the gear if there is more than one of a particular item (i.e. hand lenses, compasses, plot frames, etc.)

Table 2.1. Field gear supplied by NPS.

Gear	
Day pack	Flagging
Clip board	Plant press
Pencils	Hand lens
Quadrat frames	Collecting bags
GPS unit	Range finder
Compass	Plant Guides
Park Radio	Park Vehicle
First Aid Supplies	Pin flags
Camera	Batteries
6" ruler	

Table 2.2. First-aid kit item list.

Item	Qty	Item	Qty
Moleskin	1 p.	Antihistamine	10
Second skin	1	Cold pack	1
Ace bandage	2	gloves	pair
Cleaning wipes	10	Duct tape	1 m
Antibiotic ointment	1	Tweezers	1
Iodine	1	Scissors	1
Sterile bandages	5	Triangular bandage	1
Sterile gauze	5	Pain reliever	20
Tape	1	CA-1 accident report form	3

Preparing Field Supplies

1. Check that there are enough field sets of current dichotomous botanical keys and/or field guides. Additionally, inspect the field keys for condition and repair or replace as necessary.
2. Check to insure that there is a working radio, battery, spare battery, and charger for each crew.
3. Charge all batteries that will be used in the field, including batteries for the digital camera, laser range finder, and radios.

4. Print copies of data forms for transects and quadrats on water proof paper and print field copies of maps showing the location of the transects to be monitored.
5. Insure that the GPS units have the transect and quadrat locations and correct data entry screens installed.
6. Check quadrat frames for damage and repair if needed.
7. Transport GPS units, GPS battery charger, GPS data transfer cable, range finder, and quadrats to SAJH for use during field season.

Preparation of Directions, Maps, and Data Forms

1. Driving Directions: Maps and driving directions, maps illustrating parking locations for field crews, and ferry schedules.
2. Transect Layout: This aerial photo shows the location of transects, both annual and the rotating panel for that year. The transects are labeled and displayed in different colors to distinguish annual from rotating panels. It is a useful reference for navigating to the transect locations prior to using the GPS unit. A map of all the transects (annual and rotating for all years) may also be useful for reference in the field.
3. Quadrat Location: The location of the vegetation quadrats (map and list of coordinates)
4. Blank Data Forms: Assemble complete sets of data forms for each transect and plot being sampled in the coming season. Photocopy all data forms onto two-sided Rite-in-the-Rain paper and collate into sets.

GIS Maps and Orthophotos

Permanent maps of transects may be laminated in plastic for field use in inclement weather. Maps of transects will be stored as pdfs in the Spatial_info\Maps folder of the NCCN shared project workspace in case copies need to be printed. The GIS Specialist is responsible for creating these maps and will save the ArcMap project (.mxd file) used to create them in the project workspace folder, Spatial_info\Map_documents.

SOP 3: Orientation and Training of Field Crews

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP contains instructions for orienting and training field crews. Some paperwork will be sent ahead of time so that crew members know what to expect and feel prepared from day one. The goal is a safe and successful field visit with a satisfied crew that is well informed, able to work cooperatively with other park personnel, and prepared to follow the guidelines expected of park employees. Most of the orientation and training will occur during the first day of the field visit. The Project Lead is responsible for orientation and training of the field crews.

Training needs will be determined by the Project Lead each year once hiring has been completed. NCCN park plant ecologists are encouraged to attend as much of the training as possible, so that they may become familiar with the crews and refreshed in the measurement methods.

Information for Seasonal Employees

Soon after being hired, Field Technicians should be sent the following:

1. A written description of job expectations, duties, and responsibilities
2. Supervisor contact information
3. Start date, time, and location
4. Proposed season schedule
5. Maps of each park where they are likely to perform fieldwork, and information on local towns and amenities
6. List of field gear recommended and/or supplied by NCCN

Orientation Supplies

Upon arrival the crew hires will be supplied with:

1. An orientation schedule
2. A 3-ring binder for organizing handouts (access to a 3-hole punch)
3. A copy of the NCCN Prairie Vegetation protocol and a set of data forms. A copy of the protocol, including all appendices, is available for reference in the folder \Documents\Protocol\Active_docs in the project workspace (read-only for crews).

Paperwork and Personnel Logistics

The Field Crew Lead and field technician will be hired by the SAJH Chief of Resources and NCCN I&M funds will pay for the payperiods that they work on the Prairie Monitoring Program. All administrative responsibilities related to employment such as conduct, time sheets, IT security training, and leave will be the responsibility of the SAJH Resources Chief prior to implementation of the prairie monitoring.

Office Training

The SAJH Chief of Resources and Project Lead will give new crew members a tour of the San Juan Headquarters, American and English Camp Visitor Centers and relevant surrounding facilities. The Project Lead, SAJH Chief of Resources, and the Data Manager will assure that crew members become familiar with local computer usage, e-mail, resource information, the local park servers, location of project files, and that the crew knows which computers are available for their use. Crew members are responsible for completing the IT Security Awareness Training in the first week of employment and checking that their e-mail accounts are working properly. Because of closely shared office space, it is *critical* that the crews know what space is designated for their work and gear storage and to be considerate with noise and placement of belongings.

Crew Gear and Packing

The Project Lead will distribute items of individual gear provided by the program to crew members for the season. Crew members will check out the equipment as outlined below.

Sign-Out and Sign-In Procedure

Individual Gear: includes compasses, hand lenses, and day packs. Each crewperson should record any individual gear taken on the "Individual equipment checkout form" in the project workspace (Documents\Equipment\Gear_individual_checkout). This form must be filled out before crew members take project gear into the field. Crew members may use personal gear in place of equipment provided by NPS, but personal gear will not be replaced or repaired by NPS if it is lost, stolen, or broken. At the end of the field season, the crew and the supervisor will ensure that the equipment is returned, and that any damaged or lost items are noted for repair or replacement.

Miscellaneous Equipment

Batteries: Batteries are required for the camera, laser range finder, and GPS unit. Check for the best batteries to use for each and insure that you have an adequate supply. Rechargeable AA batteries are an option but sometimes not the best for field instruments. Always carry a spare set in the equipment case for each piece of equipment. Upon return from the field, recharge all rechargeable batteries and replace spent batteries. If disposable batteries are used, work with the SAJH Resource Chief to properly dispose of them. Notify the Project Lead or supervisor before you get close to running out of disposable batteries. For Trimble GPS units which have non-removable but rechargeable batteries, make sure to have the proper recharging cradle and cables to plug in to power source.

Safety

During the training period, the Project Lead will facilitate a discussion of the "Job Safety Analysis" form to explore all aspects of working safely. This form is also referred to as a "Job Hazard Analysis." Versions of the form from previous years are located in the folder \Documents\Reference\Safety\Prevention in the project workspace. See **Appendix F: Job Hazard Analysis** for example form.

Safe Use of Vehicles

The Project Lead will go over vehicle use and safety with crew members as follows:

1. Vehicle use
   - Key drawer or board: where keys (and spares) will be kept at all times when not in use
   - How to use government credit card for purchasing gas
   - Other items covered by government credit card (car wash, tire repair, unexpected needs such as motor oil and windshield wipers) – NOTE: Save receipts
   - How to schedule if using shared vehicle

2. Vehicle Safety
   - Safety checklist (Table 3.1)
   - Location and use of vehicle safety equipment (tire gauge, jumper cables, camera, etc)
   - Items to keep in vehicle (Table 3.2)
   - Emergency procedures
   - Procedure and equipment for changing a flat tire

Table 3.1. Vehicle safety checklist.

Check the following on your vehicle at the beginning of the field season and before each tour
Tires: pressure (do tires look low?) and tread condition
Fluids: Coolant, motor oil, transmission, and other under-the-hood fluid levels
Gas: Check that the tank is full. When traveling across park, fill the tank before leaving the last available gas station.
Lights: brake, turn signals, tail lights, headlights
Horn
Windshield (GSA pays for repairable chips)
Windshield wipers: condition
Body damage: dents or scratches
All items secure: secure items so that they are not able to fly at passengers in the event of an accident

Table 3.2. Items to keep in the vehicle.

Required gear	Extra field gear that might come in handy
First aid kit	Pin flags
Fire extinguisher	Extra data forms
Flashlight, warning markers or reflectors	Binoculars
Car jack and lug nut wrench	50 m tape
Jumper cables	
Spare tire	
Space blanket	
Camera (disposable, in case of accident)	
CA-1 Form	
Motor Vehicle Accident Report Form	

3. Safety on the Road
    - **Seat belt.** Use is required in all government-owned or leased vehicles and is required by law in the State of Washington for driver and all passengers. Do not ride in the back of pickups.
    - **Drive defensively.** Expect the other person, whether a vehicle operator or a pedestrian, to do the worst thing, and be prepared. Observe all speed regulations and traffic signs.
    - **Alert and in control.** Do not drive when sleepy, taking medication, or when other personal conditions make it unsafe to drive a vehicle. Get someone else to drive or, if alone, stop driving and nap (out of public view).
    - **Hands on the wheel.** Keep both hands available for driving at all times. Safely pull off to the side of the road before using a cell phone.
    - **Headlights.** Always drive with headlights on to increase the visibility of the vehicle. It is particularly important when driving in fog, on dusty roads, traveling in and out of shadows, and any other low light/visibility situations. Turn lights off when parking the vehicle.
    - **Conditions.** Do not operate a vehicle in an unsafe condition. Check the vehicle frequently to keep it in good mechanical condition. Lights, horn, steering, and brakes should be kept in proper adjustment at all times. Make necessary repairs as soon as unsafe condition develops. Report any unsafe conditions to your supervisor.
    - **Keep the vehicle clean.** Windows, mirrors, and lights should be kept clean and free of obstructions to increase visibility. Keep the cab and driver area clean so that material is not rolling under pedals or distracting the driver.
    - **Downhill.** Shift to a lower gear at the beginning of a downhill grade, if the grade is a long, steep descent. This will save the brakes.
    - **Speed.** Adjust vehicle speed to the driving conditions. Wet, icy or snowy roads and decreased visibility require decreased speed. Be aware of speed when changing from one type of road to another, i.e. freeway to secondary highway to gravel and adjust speed accordingly.
    - **Tail-gating.** Allow at least three seconds of travel distance between yourself and the vehicle ahead. Under slippery road conditions and poor visibility, allow more distance.
    - **Be aware of your vehicle's idiosyncrasies.** Adjust your driving accordingly.

- **Back up safely.** Walk around your vehicle to check for hazards before backing, and use a spotter to guide you.
- **Navigation.** Do not drive and navigate at the same time. If the driver needs to look at maps and photos, stop at a safe place, and then look at them.
- **Watch for animals on the road.** Most hoofed animals travel in groups, so where there is one, assume there are more, all just itching to jump out in front of your vehicle. Stop and let the animal move off the road, look for others to follow, and then proceed. If you cannot stop in time to avoid hitting an animal, it is generally better to hit it than to swerve, drive off the road, or hit another vehicle.
- **Oncoming vehicles.** Be especially alert for on-coming vehicles when driving on single-lane roads. Vehicles may be moving at high speeds in a shared lane and not paying attention when coming around corners.
- **Blind curves.** Keep as far right as is safely possible on blind curves and on single-lane roads. If the curve is blind and less than two lanes wide, slow way down and be ready to take evasive action. You may also honk as you approach a blind curve on a single lane road.
- **Yield.** Yield to *uphill* vehicles on roads wide enough for only one vehicle.
- **Parking.** Park the vehicle so that it is not a hazard to other drivers. Do not park where dry grass or other potential fuels can come in contact with your vehicle's hot exhaust system.

Safety in the field

- **Clothes**. Wear protective clothing: long-sleeved shirts, long pants, and gloves may protect you from contact with brush, rocks, and stinging insects. Trouser legs should be loose enough to avoid binding or cramping, and should not have cuffs. Hats, protective sunglasses, and sunblock (skin and lips) will help provide protection from sun exposure.
- **Boots.** Wear good quality boots that provide good support and traction, and can be water-proofed. The terrain in the prairies is often uneven and rabbit and fox holes are frequently encountered so, light-weight hiking boots with ankle support are the minimum foot gear recommended for this project.
- **Walk**. Do not run in the prairies. Take your time and plan your route. Avoid plunging through the brush. The best route of travel many not be the shortest. Routes across brushy, irregular terrain with rocks and down logs are hazardous. Keep at least one foot on the ground at all times; beware of bark sloughing from logs. Walking while reading instruments is hazardous.
- **Eyes.** Be watchful of twigs and branches, which may cause eye injury. Be especially alert when stepping up to trees that retain their small dead twigs. Keep a sufficient distance behind the person ahead of you.
- **Buddy system.** Always work in crews of at least two people.

Backcountry Basic First Aid

How to treat common backcountry injuries with first aid kit and available backcountry equipment:

- **Ankle sprain:** Use Ace bandage wrap or triangular bandage.
- **Fractures:** Control serious bleeding, treat for shock, and check for pulse of injured extremity. Remove or cut clothing from injury site, if possible gently move fractured limb to splinting position, and then splint extremity, immobilizing joints above and below the fracture site. Leave fingers and toes exposed to monitor circulation and nerve function.
    - **Leg fracture:** Splint in place. If open fracture, bandage to stop bleeding. A splint can be made from hiking or tent poles wrapped with triangular bandage and/or rope to keep splint in place.
    - **Arm fracture**: Bandage open fracture wounds. Splint with arm to body using triangular bandage. Splint with section of trekking pole or tent pole.
    - **Hand fracture**: Check for circulation and nerve impairment; splint with ruler, pencil, or stick.
- **Joint dislocation**: Common dislocations are of the shoulder but may also happen with elbows or knees. Check for pulse in injured extremity; splint with triangular bandage. DO NOT attempt to straighten any dislocated joint (serious nerve and blood vessel damage may occur).
- **External Bleeding** - Methods to control: direct pressure, elevation
    - DO NOT elevate extremity if there is a possible fracture, dislocation, impaled object, or spinal cord injury. Pressure points (use only if direct pressure and elevation fail): Brachial and femoral, are the most important to know.
    - NEVER remove a dressing that is in place, apply more dressing on top if needed.
- **Laceration**: Use butterfly bandages to close the wound, then dress with 4x4 sterile pads, bandage with gauze, and triangular bandage.
- **Puncture**: DO NOT remove an impaled object; dress and bandage around it, stabilizing the object. Treat for shock.
- **Hypothermia:** Keep person dry and warm, remove wet clothing, place person in sleeping bag. NEVER allow a person to remain in, or return to, a cold environment.
- **Heat exhaustion or stroke**: Cool the person, move the person to shade, treat for shock, and check vital signs.
- **Shock:** Two forms to be aware of are Metabolic (loss of body fluids) and Anaphylactic (allergic reaction). To treat, remember ABC (Check for Airway, Breathing, Circulation), control bleeding, splint fractures, elevate legs, be alert for vomiting, keep victim warm, and check vital signs often.
- **Animal attacks**: Cougar and bear, what to do: Stand up, DO NOT RUN, look as tall as you can.
- **Choking**: Heimlich maneuver and abdominal thrust (when person is lying down).
- **Field Equipment that can be used in First-aid procedures:**
    - Trekking Pole: The collapsible trekking pole can be used to splint leg fractures and can be pulled apart to serve as a splint for an arm fracture.
    - Bandana: Can be used as a bandage or dressing material.
    - Other: Tent poles used as splints; sleeping pad can also be used as a splint.

What to Do if Injured

- Keep a CA-1 form, a vehicle accident report form, and a disposable camera for photographing vehicle accidents in the glove box of your vehicle at all times.
- If injured, treat promptly. If immediate medical attention is required, go directly to a hospital emergency room. Try to make contact with your supervisor or the office to get instructions and assistance. Make sure the doctor fills out his/her part on the CA-1 form.
- Inform your supervisor of all injuries and ask which, if any, forms need to be filled out. Supervisors must complete the accident reporting forms as promptly as possible (e.g., within 24 hours at SAJH).
- Fill out federal accident forms completely with signatures. ALWAYS make a copy for your personal records. Give the completed forms to your supervisor. Have the supervisor check your entries for mistakes, fill out his/her section, and forward the completed forms to the appropriate person.
- Gather information. If you are in a multi-vehicle accident, provide the other parties with enough written information so that they can easily get in touch with you, your crew supervisor, and the office. In turn, you must get the following information from all involved parties and witnesses: names, addresses, phone numbers, vehicle license numbers, driver's license numbers, insurance company names, policy numbers, and police report numbers. If possible, do not admit responsibility without first contacting your supervisor.

Radio Use

The SAJH Chief of Resources will go over radio protocol for SAJH. He/she will inform the field crew members on:

- How to use the type of radio assigned to them
- How to maintain radios and batteries (Appropriate topics and terminology for radio communication
- Who to contact if radio malfunctions

Overview of Training

1. Presentations. Training will begin with a PowerPoint presentations provided by the Project Lead, SAJH Chief of Resources, Data Manager, and GIS Specialist. The Project Lead will outline the objectives of long-term ecological monitoring in NCCN, and the design of the prairie monitoring project. The presentation will cover the history of the NPS I&M program, the formation of NCCN, and the study plan for prairie monitoring, including the transect and plot selection process and the crew's role for the current field season and beyond.

   Additional PowerPoint presentations are available and may be used by the Project Lead to introduce:

   - Vascular plant species occurring in the prairies including species of special concern (i.e. rare or introduced species)
   - Vegetative characteristics of the dominant grass species in the plots.

The SAJH Chief of Resources will orient the crews to the park, travel within the park, office space, and safety procedures. The Data Manager and GIS Specialist will instruct the crews on data management and GPS use. These topics will be further addressed with hands-on training; note that crew members consistently prefer and benefit more from hands-on training than from indoor lectures.

2. Reading the Protocol. Each member of the field crew should read and become thoroughly familiar with the protocol at the start of the season. This may be accomplished in increments, facilitated by hands-on training. The Project Lead may choose to assign each person on the crew "lead" status for a subset of the SOPs (note that individual skills and interests will become more evident as training progresses). The crew member should become thoroughly familiar with the methods and materials required for his or her assigned procedures. Crew members may rotate through different tasks, but the Crew Lead is responsible to see that their assigned tasks are being carried out correctly. Time will be provided for leads of the different SOPs to undertake specialized training, if necessary. Crew members are also expected to indicate where they may need additional training.

3. Travel to Field Sites. The SAJH Chief of Resources will orient the crews to the locations of the field sites at American and English Camps. Field crews will generally drive from their SAJH duty station to each camp and then proceed on foot to the transect locations. Travel to each transect will require navigation by GPS and field maps. The SAJH Chief of Resources will outline appropriate parking locations for transects and safety considerations when parking in road edge pullouts.

4. Training on Transect and Quadrat Methodology. The Project Lead will lead the crew in field methods training over four days, one dedicated to transect mapping, one dedicated to quadrat location and monitoring methods, and two days devoted to indentification of plants and use of dichotomous keys. Even with an experienced crew, review of correct methods is critical. Data forms and GPS use for each sampling activity can be introduced just prior to the activity. Upon return from the field, the data can be entered into the database as would occur at the end of each field tour. Doing a complete trial transect and quadrat allows crew members to become thoroughly familiar with the GPS use, data forms, the individual SOPs, and the order in which the procedures are carried out.

5. Assessment. Throughout training, the Project Lead must assess the accuracy and precision of the measurements being taken by the crew, discuss discrepancies, and correct mistakes. Fieldwork must not commence until the Project Lead is satisfied that measurements are being done in an accurate, consistent and precise manner by all crew members.

Compass and Orienteering

Crew members will receive hands-on training with a compass, GPS unit, and range finder. Crew members will be instructed in the following:

1. Safety. When heading into the field, always bring one or more maps with you, and always have your own compass. Never assume this has been taken care of for you. Know where you are going, and notify another person of your plans.
2. Tools. Transect maps, data forms, GPS unit, satellite availability chart (**SOP 5: GPS Use: Navigation, Data Collection, and Downloading**), compass, clipboard, hand lens, and laser range finder.
3. Maps. Use the transect maps that have been prepared. Maps and should be printed on rite-in-the-rain paper or laminated.
4. Declination. You will need to set the declination on your compass specifically for each park and the current year. Do not use the declination indicated on a topographic map; this will not be accurate for the current year. Websites are available for determining declination by entering a zip code or latitude and longitude and the date, such as http://www.ngdc.noaa.gov/geomagmodels/Declination.jsp. The Silva Ranger-type compasses can be set by inserting the attached metal screwdriver into the small brass screw on the front or the back of the compass and rotating until the north arrow points to the appropriate degrees. To do this most accurately, check that the south tail points to the correct degrees on the clinometer part of the compass.
5. Azimuth**.** Keep compass level, and away from metal. Hold the compass at eye-level and adjust the mirrored lid so that the face of the compass is visible in the reflection. Use the sighting notch to position the compass. Turn the dial until the magnetic needle is within the box ("put red in the shed"); align other lines and center points to increase accuracy; read the degrees. It is important to practice proper positioning and alignment of the compass for accurate azimuth measurements. For less accurate readings the compass can be held out in front with the lid flat. Practice to familiarize yourself with your field compass. Check your assumptions against sun direction and other indicators. Intelligent people have been off by 180 degrees.
6. Bearing. To take a bearing from a map, lay the map down on a flat stable surface and use the compass to orient the map N-S. Align the edge of the compass with the imaginary or penciled line that adjoins your present location to your target location. Your bearing can be read directly from the compass.
7. Following a bearing. Because we rely on the GPS for navigating along the transect and locating the quadrat locations, you will only need to use a compass occasionally. However, sometimes as you approach the edge of the forest or when you are traveling through the forest GPS reception will be intermittent. In this situation, the compass can be used to keep you on the transect until you are out of the forest. In this situation, it is usually enough to sight on an object (e.g., a large tree or snag) and walk to that object before sighting again. For a more accurate bearing, two people are needed (check that the compasses are in sync): one person takes sighting and walks to the target, then sights back to the stationary person, and leap frogs. This method is time-consuming.

Equipment Training

The crew will receive hands-on training with the GPS, laser range finder, and digital camera.

1. GPS. Lead the crew through the procedures required to sample transects and locate plots. Crew members who have not used a GPS will need additional exercises to feel comfortable using the unit in the field. Those with previous GPS experience may not be

familiar with the particular model of GPS unit, data dictionary or settings, or methods used in this protocol. Review at the beginning of the field season is important for crew safety, confidence, and the collection of quality data.

Use **SOP 5: GPS Use: Navigation, Data Collection, and Downloading**. Crew members will be given a copy of the GPS operating instructions for their model of GPS unit as well as a copy of the relevant SOPs from the NCCN GPS Data Acquisition and Processing guidance document (NCCN 2009). During training the crew should understand and practice the following:

a. Power on the unit
b. Use stylus and/or control buttons to move through each menu and display screen
c. Observe configuration settings and adjust if necessary
d. Interpret PDOP/HDOP, and learn to adjust (if possible)
e. Check battery power
f. Navigate along a transect
g. Navigate to a selected target (sample plot)
h. Name and log a point for vegetation cover change on a transect (Cover_type_segment)
i. Record an offset with the GPS
j. Delete files
k. Change configuration settings if necessary
l. Record GPS data on the data form
m. Maintain the GPS unit and recharge battery (or replace batteries if applicable)

2. Laser Range Finder. The laser range finder will be used for measuring horizontal distance along the transects. Accuracy can be tested by measuring a few test distances during the initial training. The laser range finder can also be used to measure slope angle, and slope distance. See instructions on measuring distances with the laser range finder. Crew will learn and practice the following skills:
    a. Measuring horizontal distance
    b. Using measured distance to create an offset in the GPS, if needed

Data Forms

Before beginning each sampling activity in the field, the Project Lead, Data Manger, and GIS Specialist will go over the field data form. The Field Data Forms in **SOP 6 (Monitoring Field Transects)** and **SOP 7 (Monitoring Herbaceous Vegetation Quadrats)** contain all definitions and will be given to the crew first. Each of the fields on the data form will be explained, giving the crew the opportunity to take notes and ask questions.

1. Transect Monitoring Data Form
2. Quadrat Monitoring Data Form

Vegetation Training

1. Skilled and Enthusiastic Crew. Field technicians need not be experts in the Pacific Northwest prairie flora, but it is crucial that they have the ability to differentiate species in the field, and be experienced in doing so either as a result of academic training or

professional experience. Crew members must have a background in biology, botany, ecology or similar field (i.e. college classes), knowledge of the use of dichotomous taxonomic keys, and a strong interest and desire to learn by performing ecological fieldwork.

2. Plant Identification .Plant identification training will occur in 2 training events. Training for transects will occur in the first 2 days of training. Transect monitoring requires knowledge of approximately 45 dominant species: 15 grasses and sedges, 15 forbs species, 5 shrub species and 10 tree species. Training for the quadrat sampling will require a more extensive knowledge of the park's flora. Training will occur concurrent with the transect monitoring and the beginning of quadrat monitoring. Crew members will be employees of SAJH and will be familiar with many of the species prior to implementation of prairie monitoring. Crew members will be provided with a plant list of species that have been observed in SAJH (**Appendix B: Plant List of San Juan Island National Historical Park)**, origin of the species, and alphacodes for use when monitoring quadrats or for use in the 'notes' section on the transect monitoring forms. In addition, prior to the first field season, a guide will be developed for dominant and the most abundant species found in the transects and vegetation plots. This guide will include photos or drawings of each plant species and descriptions of distinguishing characteristics. In congeners, pressed specimens may be examined to facilitate identification. For species that are known to flower outside the sampling period, training will focus on vegetative characteristics.

3. Encountering unknown species. If an unknown species is encountered during the monitoring, field crews should attempt to key the plant. If the crew is unable to identify the plant, a specimen should be collected from an adjacent area, away from the transect or plot. The specimen should be labeled with a date and location and a GPS point taken and the crew lead should contact the Project Lead who will identify the specimen or contact a taxonomic expert to identify it. If it is determined that this species is not represented in the park's collection a voucher specimen will be collected (see **SOP 4: Collecting Plant Voucher Specimens**).

Taking Field Notes

The quadrat and transect data forms will have comment sections on the top where field members should record phenology of key species, weather, time required to complete the transect or quadrats along the transect, and any problems encountered. The notes taken on each data form will be helpful during data input, QA/QC, and as the Field Crew Lead writes the end-of-season report.

Crew Assignments

Each crew member will be solely responsible for a specific set of tasks. These will be assigned according to skill and interest. Divide the tasks so that each person has something to do before and after a field tour. It is the responsibility of each specific task leader to read the applicable SOPs at the onset and then again as the season progresses. Any needed corrections, additions, or improvements should be written down and presented to the Project Lead for review. We expect

methods to continue to improve, but these should be tracked during the field season and written down while they are fresh in mind. Task responsibilities for the Project Lead and a two-person crew are outlined in Table 3.3. Rearrange as seems fit for each individual crew.

Table 3.3. Task responsibilities.

Crew member	Pre-tour and tour	Post-tour
Project Lead	Prepare site maps and list of transects and quadrats to be monitored.	Review and discuss recent tour with crew.
	Coordinate with GIS Specialist and Data Manager to insure that GPS units are available and set-up and access to databases has been established for field crew.	Update crew about next tour.
	Work with the SAJH Resource Chief, GIS Specialist, and Data Manager to schedule and participate in training.	
	Be available to answer questions from field crew on methodology and species identification.	
Crew Lead	Note-taking; crew logistics; contacting supervisors; oversee data collection and data input	Contact, oversee; pick up the slack
	Plant identification	Write end-of-season field report
Additional tasks to divide between the Crew Lead and the other crew members	Vehicle; Gear organization and distribution; Data forms: pack and track; Maps: pack and track; Daily download of GPS data and transmittal to GIS Specialist; Load GPS with quadrat locations provided by GIS Specialist	Maintain batteries and technical gear; Download GPS data; Gear organization; Travel voucher forms; Data forms: photocopy and track

Literature Cited

North Coast and Cascades Network (NCCN). 2009. GPS Data Acquisition and Processing. USDI National Park Service. Available at: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm

SOP 4: Collecting Plant Voucher Specimens

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

Herbarium specimens provide a permanent physical record of the plant species occurring at the sampling locations. It is an essential component of recording plant identification and can be helpful in documenting distribution of plant species and timing of flowering, fruiting and seed set. Specimens will become a resource for future field crews and researchers. Currently the SAJH plant collection is located in the NOCA herbarium, but if SAJH purchases curatorial cabinets, a collection will be housed at the park.

These guidelines will ensure that minimum standards will be observed so that the specimens can be identified and also be of lasting scientific value.

Methods

When and Where to Collect

Voucher specimens of species that are not present in the SAJH collection should be collected when discovered. Currently 82% of all vascular plants in the park have been verified with a herbarium specimen. Each year, the Project Lead will provide the field crew with an updated species list that includes whether a voucher specimen exists. If you find a new species or plant that you cannot easily identify, you should also collect a specimen. Specimens should be collected outside the plot following guidelines described below. The voucher will serve as a record of the species present in the plot at the time of and for training of crew members on the species found at each site. Addition specimens will be collect when new species are encountered in subsequent sampling events.

How to Collect

Look for plants with well-developed flowers and/or fruits. The taxonomy of vascular plants is based on complete and mature specimens. The exceptions are trees and shrubs, which generally can be determined from mature leaf and stem structures alone. Take plants that are representative of the population you are sampling. Ideally, to the extent possible, the appearance of the finished specimen should look like the living plant. It is important to include all parts of the plant that are required for identification. Whenever possible, entire plants should be collected. Remember that mature fruits are needed for grass, sedge, rush and Umbelliferae species. Flowers and fruits are generally essential, but for many species, basal leaves and roots are needed for identification as

well. Whenever possible, show the upper and lower surfaces of leaves, and dissect flowers to reveal all parts. Remove as much soil from the roots as possible prior to pressing the specimen.

Do not collect specimens from the monitoring plot. Use the 1 in 20 rule as follows. Survey the area; if there are at least 20 plants of the species, a collection can be made. If there are insufficient numbers in the population, take a photo or try to locate more individuals in other localities.

Voucher specimens are placed on a single sheet of newspaper to be pressed. Collections should fill the newspaper page. Plants that are too large may need to be cut into sections and placed on multiple sheets and will be considered a single collection. Make sure to retain at least a representative leaf with petiole and short section of attached stem, the inflorescence, and the stem base with a portion of the root. In the case of small plants, enough specimens should be collected to cover the newspaper page. Trees, shrubs and vines only need representative portions collected. Fleshy fruits, leaves and roots can be difficult to dry; these maybe sliced into two or more sections prior to placement on the page. Cones or large dry fruits are not pressed but tagged with the same collection number as the vegetative portions of the collected plant.

A pocket knife is adequate for collecting portions of trees, shrubs, and large herbs. For roots of plant, a more substantial tool maybe required such as a trowel or hori hori knife.

Plant presses may be taken to the field; however, when backpacking, the weight and size of a press may be unmanageable. Specimens should be collected at the end of the day for day trips and on the last day, if possible, of a multi-day trip. Plants collected in the field can be placed in ziplock bags or small, rigid, tupperware-like plastic boxes. If the plants are collected in plastic bags, blowing air into the bag prior to sealing it can help protect delicate plant parts; the air will act as a cushion and offer some protection against damage while in a backpack.

Press specimens as soon as possible, either at the vehicle or as soon as you return to the office. Refrigerate specimens if it is impossible to press them the day the crew has returned from the field.

Documentation

The scientific value of specimens depends on the specimen and on the data you record when making the collection. It is important to adopt a system to ensure that the data for each specimen are recorded fully and consistently. Remember that these notes must be intelligible to another worker who may be processing your plants later on. If you are collecting just a few plants, you may write all the field notes directly on the newspaper in which the plant is pressed. Preferably, every collector should keep a pocket-sized field notebook in which he or she records each collection. Do not mix different species of plants on a sheet.

Each specimen should be assigned a unique field collection number to link the recorded collection data with the pressed specimen. The field collection number should have three components: *collector's last name – year – number*. The first collection of the season, for each collector, should be 01 and each successive collection number should proceed consecutively so that each collection has a unique number. Assign a new collection number to each specimen from a single locality on any one day. If the same species is collected on the same day, but at a

different locality, assign it a different collection number. If the same species is collected again at the same location as before, but on a different day, give it a different collection number also.

Essential data include where (general and specific locality, general and specific habitat, elevation), when (day, month, year), and by whom collected (your name). Additional information may include exposure (N, S, E, W), slope angle (flat, gentle, steep), soil texture (gravel, sand, loam) and moisture (wet, moist, dry), flower color (some blossoms fade with drying, some colors intensify), odor, relative abundance (abundant, common, infrequent, rare), and associated species. A page of your field notebook may look like this:

Species: *Festuca roemerii*
Field collection number: Bivin 2011-06
Site: Redoubt at American Camp
Date: 8-08-1984
Location: On way trail adjacent to the revegetation site
UTM: (note: be sure to include datum)
Elevation: 200'
Slope: (note: be sure to record whether in degrees or percent)
Aspect: (in degrees)
Associated species: *Holcus lanatus, Camassia quamash, Zigadenus venenosus*.

Additional information to document in the notebook includes: Size of the population, either by square meters, acres or numbers of individuals per unit area, who collected it, and any other pertinent information.

When pressing the specimens, the field collection number is placed on the sheet of newspaper containing the specimens, which relates those specimens back to the data in your notebook. Ideally, this field notebook becomes part of the permanently curated collection.

Specimen Preservation

Place the fresh specimens in a sheet of folded newspaper. When folded, the size of the paper should conform to the size of the plant press, blotters, and cardboard ventilators. The dried specimens will be mounted on a sheet of herbarium paper a bit smaller than the folded newspaper, thus each newspaper sheet of specimens equals a minimum of one finished herbarium sheet.

A little extra time taken while pressing plants will make a critical difference in the quality of the herbarium specimens. Lay out the plant(s) in a natural looking shape. Bend or fold the stems into V or N shapes as necessary to fit the plants within the folded sheet of newspaper. Be certain that both leaf surfaces are exposed and flower/fruit parts are clearly visible, i.e. not covered by stems or leaves.

When placing several small plants in a sheet of newspaper, arrange them so they do not overlap. In essence, attempt to display all diagnostic features so they will show after the plant has been dried and firmly glued to a herbarium sheet. Cut open thick, moist stems, rootstocks, dense cushions, etc., so the specimens will be flatter and dry more quickly. A deep longitudinal cut will

allow you to expose the inner portions of both halves of thick roots and stems with the uncut portion serving as a hinge.

Place each sheet of specimens between two botanical blotters and these in turn between two cardboard ventilators. Repeat this arrangement until all the specimens have been processed. Tie the press tightly with straps or rope. Place the press in the sun where it will be exposed to breezes or over a source of gentle heat.

Dry the plants as quickly as possible. Dried correctly, the specimens retain much of their original color. The best practice is to check your press every day to determine progress and to remove dry plants. Be alert for signs of mold or darkening plant tissues; the appearance of either of these means the plants are drying too slowly and a heat source is called for. You can increase the rate of drying by exchanging wet blotters for dry ones (the first change after 24 hours), using extra cardboard, and putting the thicker and more succulent specimens toward the outside of the press.

Mounting of specimens

Herbarium specimens are mounted on archival (acid free, pH neutral) paper. The dried voucher is mounted on an 11.5” x 15.5” sheet of herbarium paper. The specimen is glued to the paper with archival quality glue or taped with archival tape. Seeds or plant parts that have come loose from the specimen can be attached to the voucher in small packets which are glued or taped to the herbarium sheet. Care should be taken to avoid obscuring plant structures that may be critical for identification.

SOP 5: GPS Use: Navigation, Data Collection and Downloading

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP provides general information on preparation for and best practices in field data collection with a GPS as well as information specific to implementing the NCCN Prairie Monitoring protocol at San Juan Island National Historical Park (SAJH). This SOP also provides the Field Crew with detailed instructions on using the GPS to navigate along transects during prairie vegetation cover mapping or to prairie quadrat sampling locations. Responsibilities for all aspects of GPS data collection and processing are also detailed.

The material in this SOP should be used in conjunction with the step-by-step instructions for collecting and exporting GPS data in the NCCN Global Positioning System Data Acquisition and Processing guidance document available on the NCCN internet site at: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm. The guidance document contains appendices on the use of Trimble TerraSync software (GPS data collection) and Pathfinder Office software (GPS project workspace set-up, GPS data download, post-processing (differential correction), and export to GIS). The appendices also detail the methods of GPS unit operation, data collection, data transfer, data import/export as well as list the NCCN-recommended settings/configurations for a variety GPS receiver makes and models. The Prairie Vegetation Monitoring protocol requires high positional accuracy while navigating along transects with a GPS and will therefore typically use the Trimble GeoXT GPS units; refer to the applicable appendices in the guidance document for additional information about these units.

Prairie vegetation monitoring data collection with the GPS will consist of mapping (with point features) the start of each change in cover type along each of the transects (of which there are 20 and 15 in the annual panel at American and English Camps, respectively, and 5 in the rotating panel at each Camp).

General Practices for GPS Data Collection

Training

Field crew members are required to receive GPS training for the particular make and model of GPS unit they will be using prior to conducting field work (see **SOP 3: Orientation and Training of Field Crews**). For the Prairie Vegetation Monitoring protocol, Trimble GeoXT units have been loaded with the Trimble TerraSync Professional software program for GPS data

collection. Trimble Pathfinder Office is the software program installed on office computers for downloading, post-processing and exporting GPS data. Contact the GIS Specialist to schedule training in the use of Trimble GPS units and the Pathfinder Office and TerraSync software programs in advance of the field season start (see **Appendix C: Yearly Project Task List**, in the protocol).

Important Considerations in GPS Data Collection

Regardless of GPS receiver type used, certain data collection standards apply. Most of the quality control measures below can be specified by the user and should be followed whenever possible to produce the most accurate data.

- Satellite availability and satellite geometry (Positional Dilution of Precision, or PDOP):
  Acquiring at least four satellites will enable determining a 3-D position. Satellites that are spread out in the sky (better geometry) will produce a more accurate position than when they are clustered together. Mapping accuracy can be increased by using mission planning charts (available in Pathfinder Office on the computer or TerraSync Professional on the GPS unit) and targeting data collection to the times of day when satellite availability and geometry are best. PDOP should be 6 or less if possible. If vertical precision is not essential and terrain makes connecting to satellites difficult, HDOP (Horizontal Dilution of Precision) may be used instead of PDOP, and should be set to 4 or less.
- Length of time GPS data file is open:
  Positional accuracy will be better the longer a GPS file is open and the more GPS positions are logged and averaged for a given point location. For Trimble GPS units, it is recommended that at least 60 positions be logged for each point feature mapped.
- Multipath error, or signal interference:
  While mostly beyond a user's control, some adjustments can be made to minimize multipath error. These include positioning the GPS in the most unobstructed view of the sky as possible, using offsets from areas of better satellite reception to the target location if that location is under canopy or other obstruction, or using an external antenna.
- Signal to noise ratio (SNR):
  Trimble units allow a minimum ratio value to be set in the configuration such that positions with SNR below that value are not logged. A SNR value of 39 is recommended for Trimble units.
- Elevation mask:
  Trimble units can be configured to set an elevation mask to screen out satellites that are low on the horizon. The minimum elevation of 15 degrees is recommended.
- Real-time differential correction:
  Real-time correction improves the accuracy of GPS data collected in the field, even if it will be post-processed later in the office. Until recently, real-time corrections were difficult to obtain in some NCCN parks due to variable topography and extensive canopy cover. With the launch of a new WAAS satellite that orbits at a higher elevation above

the horizon, it is now easier to obtain real-time signal in NCCN parks. Because navigation and cover type mapping for this protocol requires high spatial accuracy, it is strongly recommended that whenever possible, real-time capability is enabled on the GPS unit.

Coordinate System and Datum

The NCCN uses the Universal Transverse Mercator (UTM) coordinate system, zone 10 North (10N), and North American Datum of 1983 (NAD83 (Conus) CORS96) for all spatial data sets. Satellites broadcast positional information using the World Geodetic System 1984 (WGS84) datum, but most GPS units can be configured to display the position coordinates in UTM, NAD83. Be sure to set the GPS unit display to this coordinate system and datum (refer to the NCCN GPS Data Acquisition and Processing guidance document).

GPS field coordinates (coordinates displayed on a GPS receiver's screen while the GPS is receiving satellite signals) and the datum should be recorded on the field data forms. These coordinates will become the best measure of spatial location in the event a GPS data file is lost or corrupted. Be aware that these coordinates read from the GPS unit display in the field cannot be post-processed and are in the coordinate system and datum that were selected for the unit's display (which should be set as UTM 10N, NAD83 (Conus) CORS96). These coordinates consist of an easting (six digits) and a northing (seven digits).

Office Preparations and Staff Responsibilities

The Project Lead should contact the GIS Specialist to schedule GPS unit use for the season, and to have the units prepared for field use (configuring unit settings; loading background imagery or layers, transects, and data dictionaries, etc). The Project Lead should also arrange a schedule with the GIS Specialist for the regular delivery of GPS transect data from the field crew as well as providing the crew with satellite availability charts for their scheduled field tour dates. At the end of each transect mapping day, the Field Crew will download the GPS transect data files and save in the \Rover_files\Raw folder of the temporary workspace created for them in the project workspace. The GIS Specialist will be responsible for post-processing these GPS data files and calculating the locations of quadrat samples based on these GPS transect data. When all the transects have been sampled and quadrat locations calculated, the GIS Specialist will place a file containing the quadrat location coordinates in the \Import_files folder of the project workspace and notify the Field Crew, who will then load these coordinates onto the GPS.

Project Workspace Set-up

Contact the GIS Specialist to have Trimble Pathfinder Office software installed on the office computer, and if needed, assistance with creating the appropriate GPS data folders within the Prairie Vegetation Monitoring project directory structure (Figure 5.1). The GPS-related folders are organized by year and include: 'Data_dictionary' for any GPS data dictionary files, 'Import_files' for background layers or maps to display on the GPS unit as well as quadrat location coordinates to be loaded onto the GPS, and 'Rover_files' for the data collected with the GPS unit. The Rover_files subfolders include: 'Base' for base station files used in differential correction, 'Export' for GPS data exported to GIS or database formats, 'Processed' for GPS files

that have been post-processed, and 'Raw' for the original, un-processed GPS rover files. The Field Crew will also have a GPS_data\Rover_files directory in the temporary workspace created for them in the project workspace.

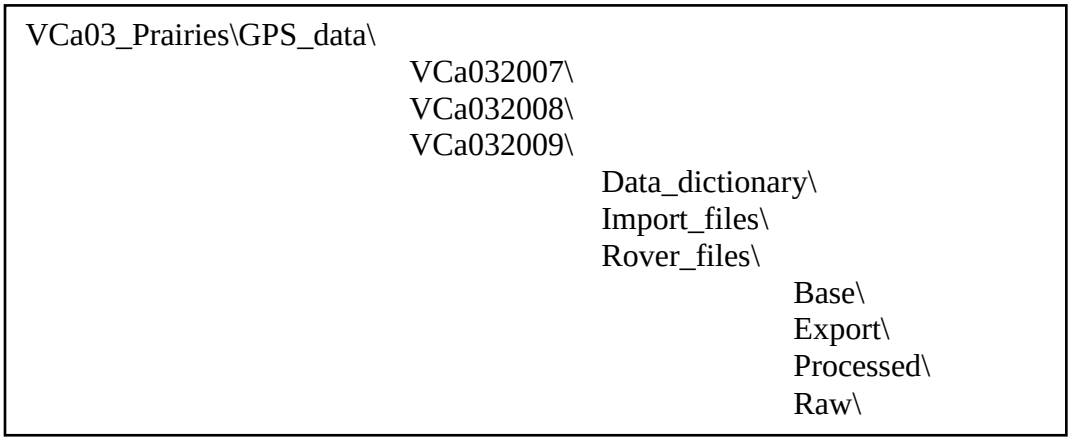


Figure 5.1. Example of folder organization for GPS data within project directory structure.

Data Dictionary

GPS units will be loaded with a project-specific data dictionary named VCa03_YYYY.ddf (where VCa03 is the project code and YYYY denotes the year) which will be used when mapping change in cover type points along transects as well as any other features of interest. The data dictionary has one custom point feature types that may be collected: 'Cover_type_segment.' The Cover_type_segment feature is used for mapping the changes in cover type along the transect. This feature has five attribute fields, three of which require user data entry, one is an autonumbering function, and one is an optional comment field: Unit (AC or EC), Panel, (1-6), Transect (1-20), and Comment. It does not require any attribute information be entered but does have a 50-character 'Comment' field into which special notes or observations may be indicated. It also has an auto-incrementing field which is used later for QA/QC and synchrony with field data in the project database when the GPS data are uploaded (i.e. it is the unique identifier for each cover type segment). This field is called 'Auto_number,' and it is NOT OK for there to be duplicate Auto_number values.

If some other feature of interest needs to be mapped that is not a cover type segment, the Field Crew can always select the 'Point_generic' feature type which is available in all data dictionaries, whether default or custom. The Point_generic feature has no attribute fields but does have a 32-character 'Comment' field into which notes can be entered about what the feature is.

GPS File Naming Convention

File names should begin with the letter that has been assigned to and that uniquely identifies the GPS unit being used. GPS data file names should be recorded on the field data forms.

Please name each file using the following format: GPS unit letter, two digit year, two digit month, two digit day, two character camp code (AC or EC) and three to five digit transect ID

(transect ID is in the form of panel number followed by a hyphen and then the transect number). For example, I090708AC1-1 for GPS unit I on July 8, 2009 and at American Camp transect 1-1. There are six panels in each camp – one annual panel (panel 1) and five rotating panels (panel numbers 2-6). Panel 1 (annual) has 20 transects at American Camp and 15 transects at English Camp. Rotating panels are monitored every five years and each panel has five transects.

Field Data Collection

The GIS Specialist will be responsible for loading background layers of the transects to be mapped onto the GPS at the start of each field season. Field crews will then be able to display the transects on the GPS and navigate along them as cover types are mapped. After all the transects have been sampled, the GIS Specialist will provide the Field Crew with the coordinates for the quadrat locations. The Field Crew will then be able to select the coordinates of target quadrat locations and navigate to each target site for quadrat placement and sampling. Step-by-step instructions for these two types of navigation (transects and quadrats) follow below.

NOTE: When using the background map display screen to navigate, be aware of the display scale at the bottom of the screen. Trimble GeoXT units will default to the scale of the background map if it is selected for display. Use the Zoom tool to zoom in as needed to achieve the appropriate scale (see Step 2.C.iv below) for navigation along a transect.

Before collecting any GPS data in the field, the Field Crew should turn on the GPS and verify that all the settings are correctly set as specified in the NCCN Global Positioning System Data Acquisition and Processing guidance document. It is also extremely important to verify that the correct date and time are displayed on the GPS unit screen before beginning any data collection. If GPS data is logged to a data file with the wrong date/time stamp, post-processing back in the office will not be possible.

The Field Crew should also wait a few minutes with the GPS turned on to allow the unit to communicate with the satellites. In particular, if the WAAS satellite is currently being tracked, this will increase spatial accuracy as it allows for real-time differential correction (the GPS data will still be post-processed in the office). The WAAS satellite will appear as an airplane inside a diamond (see the NCCN Global Positioning System Data Acquisition and Processing guidance document for more detail on using real-time differential correction capabilities).

Navigation Along a Transect and Mapping Vegetation Cover with GPS

1. First look at a hardcopy field map and determine the general location of the transect along which prairie vegetation cover will be mapped. When in the vicinity of the start (south end) of the correct transect, turn on the GPS receiver and start TerraSync.

2. Within TerraSync, the ***Map* window** allows tracking the current GPS position and data collection as well as displaying *one* background file, in this case, a file containing the SAJH prairie transects (there are two files, one for the 20 ‘pure’ or annual panel transects and one for the current year’s five rotating panel transects). This also allows navigation along the predetermined transects so that changes in prairie vegetation cover can be mapped (see Step 3).

A. To load the transect background file, select *Background File* under the *Layers* menu and select one of the available files (either SAJH_Pan1 or SAJH_PanX, where 1 refers to the annual panel and X denotes one of the five rotating panels).

B. Turn the background display on from the *Layers* menu by checking *Background*.

C. Zoom in and out (or pan) the view by selecting a tool from the tools drop-down list, just below the upper left corner. The current GPS location will appear on the ***Map* window** as an X, and all transects should also be visible. If they are not, tap the 'zoom to extents' icon at the bottom of the window (a circle with an = sign in the center). The scale bar at the bottom right should then display as 1 inch = about 2km.

   i. Under the *Options* menu, toggle on *Auto Pan to GPS Position* by tapping (black dot will appear to the left of the text) so that the ***Map* window** display will automatically re-center the current position as you travel and approach the edge of the display screen.

   ii. Walk towards the start of the desired transect until the X is superimposed on the start of the transect. **Note**: You will need a hardcopy field map of the transects to be able to identify a specific one as the background file does not label them.

   iii. Now zoom in to a closer view (for example 1 inch:500 m) but not so close that the X is no longer visible on the screen (or is 'jumping' around too much to stay onscreen). The X will likely no longer appear superimposed on the transect at this scale.

   iv. Again walk until the X is superimposed, zoom in even closer, and repeat this process until at a scale of 1 inch:10 m (or possibly even 1 inch:5 m, if the GPS position re-calculation does not cause the X to jump around too much and off the screen). This should be the scale at which the transect is mapped.

3. The GPS will be used to record the location (a point) where a prairie vegetation cover type changes along the transect. Be sure to have yourself already positioned at the transect start as described above in steps 1.C.i - 1.C.iii.

   A. First, create the data file in which the GPS positions will be stored.

      i. In the ***Data* window,** select *New* from the drop-down sub-menu. The default file name begins with a letter prefix that identifies the specific GPS unit, followed by the date. Change the default filename by selecting all but the first letter prefix and typing an appropriate file name (see GPS File Naming Convention above). Please be sure to retain the initial letter prefix identifying the GPS unit.

      ii. Select the SAJH Prairie Monitoring Data Dictionary (VCa03_YYYY) from the drop-down list, then tap *Create*. It may be necessary to tap the tiny keyboard icon at the bottom center of the screen to minimize the keyboard in order to see the Data Dictionary selection field.

iii. The *Confirm Antenna Height* dialog box pops up – tap *OK* to confirm the 1m setting, if appropriate (if the GPS is held at about waist height).

iv. In the Choose Feature pane, note that there are four feature types available: one custom point feature for SAJH Prairie Monitoring (Cover_type_segment) and three 'generic' feature types. The custom point feature Cover_type_segment should already be selected.

v. Switch to the ***Setup* window**, then tap the *Logging Settings* button and verify that the logging interval is set to 1 second for Cover_type_segment (this should be the default).

B. In the ***Data* window**, with Cover_type_segment point feature type highlighted in the Choose Feature pane, tap *Create* to create a point that maps the start of the transect as well as the beginning of the first vegetation cover type.

i. The GPS should begin logging positions; if not, select Log from the *Options* menu, or toggle the Pause/Log button in the upper right corner:

ii. Tap *Log* ► to begin logging, the button will change to *Pause* ▌▌.

iii. Tap *Pause* to stop logging, the button will change back to *Log*.

iv. While the GPS is logging positions (**NOTE**: once a file is open, do not move from your location as this will alter the average position calculation):

a. Record the UTM northing on the field data form. This is displayed on the ***Status* Window** (select *Skyplot* from the drop-down sub-menu) on the lower left part of the screen. For the very first segment of the transect only, also record the UTM easting on the field data form. The UTM northing can also be accessed by tapping the **X** denoting your present location in the ***Map* Window**.

b. Use the data dictionary drop-down menus to select the Park unit (AC or EC), Panel (1-6), and Transect (1-20). **NOTE**: for English Camp, remember that there are only 15 transects.

c. Note the Auto_number value towards the screen bottom and write this number on the field data form. This field should only be edited under the special circumstance identified below in Step 5.E.

d. The 'Comment' field is available for free text entry of any special notes or observations (up to 50 characters).

v. When at least the minimum of 60 positions has been logged, tap *OK* to stop logging and again to close the feature. If fewer than 60 positions have been logged, a warning will be issued. The more positions logged, the higher the spatial accuracy.

C. Switch to the ***Map* window** and begin walking along the transect until the prairie cover type changes; a new point feature will now be collected that will mark both the end of the previous cover type and the start of the next. The attributes recorded on the field data form for this new point will apply to the new (i.e. not-yet-walked) cover type in front of you.

   i. In the ***Data* window**, select 'Cover_type_segment' feature type again and tap *Create* button to create a new point marking the start of the next cover type.

   ii. Proceed as in steps 3.B.i - 3.B.iv.

      a. For all transect cover type segments after the first, you only need to record the last four digits of the UTM northing on the field data form.

      b. While it is not necessary to record the UTM easting with each new cover type that is mapped, do check the easting on the GPS each time to verify that you are still on the transect and that the ***Map* window** is zoomed in to at least 1:10m or preferably, 1:5m.

   iii. If a point needs to be deleted, Select *Update Features* from the drop-down sub-menu in the ***Data* window**. All the cover type points will be displayed in a list in the order they were mapped with the GPS.

      a. Highlight the desired point by tapping once (double-tapping will open a new window used to update the point's coordinates with GPS – tap *Cancel* to escape this window).

      b. From the *Options* menu, select *Delete.* The point will be displayed in the list with a strikethrough.

      c. If you are done mapping cover changes on the transect, tap *Close* to close the data file. Otherwise, select *Collect Features* from the drop-down sub-menu of the ***Data* window**.

D. Continue until all cover types are mapped, then a final point must be created to indicate the end of the transect.

   i. In the ***Data* window**, select Cover_type_segment a final time and tap *Create*.

   ii. While logging a minimum of 60 positions, enter "End" in the Comment field to denote the end of the transect.

   iii. Tap *OK* to close the feature. Then tap *Close* button to close the file.

E. If a rare plant or exotic plant of concern is discovered along a transect, it can be mapped separately without needing to close the currently open transect points file. However, the last point feature mapped (cover type) must be closed.

i. From the ***Data* window**, select the default point feature 'Point_generic' in the Choose Feature pane, tap *Create*, and log at least 60 positions.

ii. While logging, enter any notes about the plant of interest in the 'Comment' field. It is limited to 50 characters.

iii. Tap *OK* when finished.

F. Create a new file for the next transect and proceed as before, from the beginning (step 3A).

4. Occasionally, terrain or vegetation may prevent standing at the precise location where vegetation cover changes, or the actual cover change location has poor GPS conditions (e.g. under tree canopy). In these situations, the GPS can be used to map the inaccessible location through the use of 'offsets' as follows:

A. Configure the GPS settings if needed:

i. From the ***Setup* window**, tap *Units*. Verify that 'Offset Format' is set to Horizontal/Vertical, 'North Reference' is set to Magnetic, and 'Magnetic Declination' is correctly specified (should be roughly 17°).

ii. Tap *OK* to exit *Units* setup.

B. Move to the nearest location along the transect where satellite coverage is available, and measure the bearing (azimuth) and distance from your current location to the cover change location.

i. Use a compass to measure bearing (degrees) and a laser range finder to measure the distance in meters. Make sure the compass declination is set correctly.

ii. If the distance is short and the cover change location is accessible but just not in a setting favorable to GPS, a measuring tape may be used instead of the range finder.

iii. Record this offset bearing and distance on the field data form

C. Create a new feature and begin logging positions as in Step 3.B. While the GPS is logging positions, select *Offset...* from the *Options* menu. Use the default offset type, 'Distance – Bearing.' Tap *Next*.

i. Enter the compass reading (degrees) into the 'Bearing (M)' field. You may need to tap the tiny keyboard icon at the bottom center of the screen to open up the keyboard and enter a value.

ii. Enter the distance value (meters) in the 'Horizontal Distance' field.

iii. It is unlikely at SAJH that a large difference in elevation will exist between where the field crew is using the GPS and the actual cover change location, so the Vertical Distance field may be left blank. If there is a significant slope (greater than ~10 degrees), then the vertical distance should be estimated and entered as this will affect distance. When the three fields are complete, tap *OK*.

iv. Once the minimum of 60 positions (preferably more) has been logged, tap *OK* to close the feature.

5. Important points (and common user errors) to keep in mind during data collection:

A. If a transect cannot be completed in a single day, be sure to reopen the GPS file from the previous day's mapping effort rather than creating a new file. This ensures that the Auto_numbering will continued from the last mapped point.

i. From the ***Data* window**, select *Existing File* from the drop-down sub-menu, select the previous day's data file for that transect from the list of available files, then tap *Open*.

ii. Continue mapping cover type segments by creating new features as in Step 3.A.iv above.

B. Always be sure to zoom in to at least 1:10m or 1:5 m when navigating along the transect and mapping cover changes. If the map view is at a 1:20 or greater, critical accuracy of the mapped points is lost!

C. Always select the correct Data Dictionary. Failure to do so will result in the loss of the auto-numbering function which is the unique identifier necessary to link the GPS data to the field data entered in the database.

D. Always navigate and map cover changes from the very start to the very end of the transect unless it is not safe to do so, in which case be sure to note this deviation on the field data form.

E. The field data form recorder and the GPS operator need to be in clear and constant communication about what cover type segment they are mapping and need to continually verify that the Auto_number from the GPS matches what is recorded on the field data form. Scenarios where these could become out of synch:

i. If the field crew realize they missed a change in cover type at some point along the transect and need to go back and GPS the location, they must delete all intervening points before mapping the missed segment. The Auto_number will record the value that would have been used for the next point before the intervening points were deleted. While the GPS is logging the missed point, and before closing the feature and moving on to the next segment, manually edit the Auto_number to increment by one from the last retained point. The Auto_number should then increment as normal for all subsequent segments and be recorded on

the field data form as it appears on the GPS. Make sure that the data form is corrected for the following segments as needed (adjust auto_numbers).

ii. If the field crew realize after the fact that no GPS was recorded for a point (i.e. the point feature in the GPS was not correctly saved for whatever reason), there will be no Auto_number value recorded on the field data form, only the GPS coordinates read from the unit's screen.

iii. If a situation arises where a cover change was erroneously mapped and the point needs to be deleted, delete the point. The replacement point will have the Auto_number value that would have been used for the next point before the erroneous point was deleted. While the GPS is logging the replacement point, and before closing the feature and moving on to the next segment, manually edit the Auto_number to increment by one from the last retained point. The Auto_number will continue incrementing correctly from that point on.

Navigation to Sampling Quadrat Location with GPS

The GPS will also be used to navigate to each target quadrat location where an herbaceous vegetation sampling quadrat will be placed. The GIS Specialist will create a data file (SAJH_quadratYYYY.imp, where YYYY denotes the year) containing the coordinates of all the quadrats and place it in the project workspace folder \Import_files. The Field Crew will load this file onto the GPS. The crew members will then be able to select these quadrat locations, one at a time, as a navigation target.

Very important! Be sure that the coordinate system and datum of the data file is the same as that specified on the GPS unit display before transferring to and opening on the GPS unit. To navigate to the first quadrat, be sure to have yourself already positioned on the correct transect along which quadrats will be established and proceed as follows:

1. From the ***Data* window**, select *Existing File* from the drop-down sub-menu, select the appropriate data file from the list of available files, then tap *Open*.

   A. Note: do not tap *Begin* – this is reserved for updating a point's coordinates using the GPS, which is a different objective.

   B. Tap once on a point to select it (double-tapping will open a new window used to update the point's coordinates with GPS – tap *Cancel* to escape this window).

   C. Points can be sorted by distance from the current location by tapping the *Distance* column.

2. Switch to the ***Map* window**, the selected point will be displayed with a box around it.

   A. From the *Options* menu, select *Set Nav Target*, then select the data file name for the quadrat coordinates (VCa03_quadratsYY, where YY denotes the year). The selected point will now be displayed with a box and two green flags crossed.

B. Go to the ***Navigation* window**, which will show one arrow pointing to the target location (small triangle in the outer circle) and another arrow pointing in the actual direction of travel (inside the inner circle with long line through it).

   i. The goal is to superimpose the two arrows. Walk in the direction in which the two line up. When they are perfectly in line, the target arrow will turn black.

   ii. The ***Navigation* window** will indicate the distance and bearing to the target and will indicate in what direction to turn as needed.

   iii. Use the *Options* menu to specify Navigation Options:

      a. Close Up Range: The 'Close-up' screen can be activated when positioned within a specified distance of the target by choosing the default value of 5 meters, or typing in a preferred distance. Or select None to prevent the Close-up screen from displaying.

      b. Close Up Style: Specify the style of the Close-up screen by selecting map- or GPS-centered.

C. To select a different point, select *Clear Nav Target* from the *Options* menu, then either tap another point in the ***Map* window**, or select one from the ***Data* window** as described above.

Important Reminders and Caveats for Field Data Collection with GPS

1. If data collection is paused for more than about 15 minutes, battery power can be preserved by putting the unit in suspend mode. This is done by briefly depressing the power button – the screen will go black. Press the button again to turn on and restore the unit exactly as it was, i.e. if TerraSync or any files were open, they will still be open. There may be a 30-second delay in reactivating the GPS receiver and reconnecting to the satellites.

2. Occasionally, a unit may fail to come out of suspend mode. DO NOT PANIC.

   A. If this happens, perform a soft reset by holding down the power button for about 5 seconds (refer to Trimble manual). There will first be a warning message – continue holding down the button until the screen is completely blank. It will reboot automatically.

   B. If this does not work, depress the power button for at least 15 seconds to perform a soft reset and completely turn off the handheld. Again, there will be the warning message, then a briefly blank screen, and then the unit will begin to reboot. Continue holding down button until the reboot screen becomes blank. Then briefly press the power button again to restart the unit.

   C. TerraSync must be restarted and the Date/Time verified because it may revert to 6/01/1999 whenever the unit is turned completely off (very important!). Alternatively, once the unit reconnects to satellites (about 5 minutes), the Date/Time will automatically update if it did revert to 6/01/1999.

3. Make sure to recharge the GPS unit fully (with the support module connected to a power source) at the end of the day if collecting field data again the next day.

    A. Check the level of charge under Start/Settings/Control Panel/Power or double-tapping the battery icon in the status bar at the bottom.

Downloading and Processing GPS Files

Transferring GPS files requires a computer, a data-transfer cable, and having GPS software installed on the computer. GPS receivers typically come with manufacturer-specific software and data-transfer cables. Refer to the NCCN Global Positioning System Data Acquisition and Processing guidance document (http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm) or the GPS user manual for instructions on transferring files from the GPS unit to a computer.

It is extremely important that after each day of field work, the Field Crew transfers all GPS data files from the GPS unit to the computer. Files should be saved in the 'Rover_files\Raw' folder in the temporary workspace created for them in the project workspace. Communicate with the GIS Specialist to determine where and how GPS files should be stored and if other procedures are necessary for delivery of files for processing.

The GIS Specialist will be responsible for all GPS file processing including differential correction. The GIS Specialist can export GPS data into GIS or database formats upon request throughout the field season. Any GIS shapefiles will be saved in the 'Export' folder of the project directory structure. At the end of the season, the GIS Specialist will transfer all the GPS files from the Field Crew's temporary workspace to the appropriate subfolders of the GPS_data\ folder in the project workspace. The GIS Specialist will also be responsible for conducting GPS coordinate data quality assurance and for loading and processing GPS data in the project database.

SOP 6: Monitoring Field Transects

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP describes the methods used to monitor vegetation cover types along transects in the prairies of San Juan Island National Historical Park.

Equipment

A GPS unit is needed to monitor the prairie transects. The unit must be of high accuracy. Currently the unit used is a Trimble GeoExplorer XT. Data will primarily be recorded on paper data forms; the GPS unit will be configured to automatically number each segment of vegetation cover type mapped in sequence for linking the GPS coordinate data to the field data entered into the project database at the end of the field season. The data form is presented at the end of this SOP (Figures 6.1, 6.2). Data forms should be copied on Rite-in-the-rain or a similar water resistant paper.

A compass is a useful tool to ensure that the transect bearing is maintained as crews walk the transect line.

Procedure for Monitoring Transects

A set of transects will be monitored on a yearly basis; these are the Annual Panel. A second set will be monitored on a rotating basis; these are the Rotating Panels. The annual panel in American Camp has 20 transects while the annual panel in English Camp has 15 transects. There are five rotating panels in each camp, composed of 5 transects for a total of 25 transects per camp. Five transects of the rotating panel are sampled each year. The rotating panel transect sampling will be completed in a 5 year cycle. This means that each year, 25 transects will be monitored at American Camp (20 annual and 5 rotating) and 20 transects (15 annual and 5 rotating) will be monitored at English Camp. The transects will be loaded onto the GPS unit by the GIS Specialist at the start of the field season. The coordinates of the transect start and end points will also be available as a project database export so that the Field Crew can take a hardcopy into the field.

Monitoring should be accomplished with two individuals. One person will be responsible for mapping vegetation cover type changes along each transect with the GPS unit and the other will record the data on the paper data form. The individual operating the GPS unit will ensure that the field crew remains on the transect using the GPS unit as guide while sampling. The other

individual will be responsible for observing the changes in the vegetation communities (% nativeness as well as growth form) and filling out the data form.

The Field Crew begins by positioning themselves at the beginning of the transect, e.g. at the south end (see **SOP 5: GPS Use: Navigation, Data Collection and Downloading** for specifics of using the GPS to navigate to the transect start). They observe and record the vegetation cover type of the first segment in front of them. This information is entered onto the data form and the GPS is used to map both the start of the transect and the beginning of the first segment. The crew will then continue to walk the transect from south to north documenting the vegetation in terms of physiognomic type (i.e., herbaceous, shrub, tree, bare, or developed), nativeness of the vegetation (i.e., exotic or native), and a disturbance modifier (grazed or not). The transect is divided into segments which are defined by physiognomic type, nativeness, and disturbance and mapped at a resolution of 1 meter (in length). Therefore, if the physiognomic type, nativeness of the vegetation, or presence of grazing changes for a distance equal to or greater than 1 meter, then a GPS point is taken and new cover type is recorded. The observers then continue to walk the transect, mapping a new segment each time the vegetation composition or structure changes. This continues until the end of the transect is reached.

Monitoring transects

- Navigate to the beginning of the transect using the GPS unit.
- Monitoring transects should always begin at the southern end of the transect. The transect is sampled moving north to the northernmost end point.
- At the beginning of the transect, a GPS point is collected. Procedures for GPS point collection are found in **SOP 5**. This initial GPS point documents both the beginning of the transect and the southern end of segment 1. As the observers continue along the line, GPS points are collected to mark the beginning of each segment. Segments are defined by physiognomic type, nativeness of vegetation, and a disturbance modifier (animal activity recognized by grazing or burrows) (Table 4). If any one of these three conditions changes, for more than 1 meter, a new segment is defined. Review of the decision tree (Figure 6.3) in the Narrative of this protocol should assist in determining when to identify a new segment.
- The sampling unit is a line transect, but it may be helpful to visually examined vegetation 0.5 meters on either side of this line.
- The following questions in the decision tree will lead to the identification of the vegetation type:
    - Is the area a road or a trail >1 meter wide?
        - Record as D for developed. Neither nativeness nor cover attributes apply here.
    - Is vegetation cover <10%? If it is not a road or trail and is >1 meter in length along the transect:
        - Record U for unvegetated and record the predominated substrate:

            Sand, gravel, rock, soil, log or water

- Is the cover ≥50% trees?
    - Record as T for tree. If the ≥50% of the tree cover is native, then record N for native. If the <50% of the tree cover is native (so this means exotic tree cover must be >50%), then record E for exotic.
- Is the cover ≥50% shrubs?
    - Record S for shrub. If ≥50% of the shrub cover is composed of native species, record N for native. If it is ≤50% cover of native species, record E for exotic.
- Is the cover herbaceous?
    - If the cover is herbaceous and the cover of native species is ≥50%, record N for native. If the cover by native species is ≤50%, record E for exotic. ***Note*** that cover can add up to more than 100% due to multiple canopy layers. It is possible to have >50% native cover and >50% exotic cover. Since the origin of the cover segment is based on the amount of native species, this would still be a native herbaceous segment with >50% exotic cover as the modifier (see next step).
    - In herbaceous segments, we are interested in the quality of the herbaceous cover and one method we are using to evaluate the origin and cover of the"herbaceous subvegetation". If the segment is determined to be native, the "herbaceous subvegetation" is the non-native (exotic) component. In the herbaceous subveg origin and cover column of your data sheet, record E (for exotic) and the percent cover of the non-native (exotic) vegetation. Non-native cover is recorded using the following cover classes: 1-10%, 11-49%, or ≥50%.
    - If the segment is determined to be exotic, the percent cover of the native vegetation must also be recorded using the following cover classes: 0-10% or 11-49%. If the cover of natives was greater than 49% it would be considered a native herbaceous community.
- If the cover is determined to be herbaceous, is it grazed?
    - If more than 25% of the herbaceous vegetation is grazed, record Y for yes; if less than 25% is grazed, then record N for no.

The Data Form

One technician in each crew (usually the Crew Lead) will be responsible for ensuring that these data are completely recorded. Fill out the form as follows:

Camp (AC or EC): Indicate in which camp the transect is located (AC for American Camp and EC for English Camp)

Transect: Record the transect number in the format #-#. For example transect 5 in panel 1 is numbered 1-5.

Start date: Month, day and year the sampling occurred.

Start time: Record the start time for the transect sampling, use the 24-hour format.

End date: Month, day and year the sampling was completed if not accomplished in a single day.

Total Hours Spent: When you complete the transect, record the total time (in hours rounded to 0.25 hours) that you spent to complete the transect. Only record the tme you worked on the transect (i.e., subtract lunch breaks or any other break times).

Observers: Last name and first initials of individuals sampling the transect.

Transect Easting or Northing: Record the transect easting for American Camp transects and the transect northing for English Camp transects, Refer to **SOP 5** on GPS use.

GPS file: Record the file name displayed on the unit, Refer to **SOP 5** on GPS use.

Weather: Record the weather in broad terms; rain, sunny, windy, etc.

Event notes: This is a space to note unusual sightings (wildlife, for example) or other information that may be useful. If sampling occurred over more than one day, note here any changes in observers, weather, or other pertinent information.

Phenology: Record the phenological stage of these species after the transect is completed. Record the stage that best describes the population as a whole.

The following three items will be filled in as the data is entered in the database, after the crew returns to the office:

Entered by/date: _____: Initials and date to indicate when and by whom the data were entered into the database (office only)

Updated by/date: _____: Initials and date to indicate when and by whom the field data were updated after returning from the field (office only)

Verified by/date: _____: Initials and date to indicate when and by whom the data were verified for accuracy in the database (office only)

Segment number: The segment number is assigned through an "auto-numbering" routine in the GPS unit, check the GPS segment number each time you record the segment number.

UTM N / E: Record the last four digits of the northing UTM (at American Camp) or the easting UTM (at English camp) from the GPS unit (see **SOP 5**). The UTMs are recorded at the beginning of a new cover type.

X if no GPS: If no GPS point is taken, an X is marked in this column. This may occur if for some reason the vegetation if too thick to walk through (rose shrubs, for example) or if satellites are

not available, which can occur in dense forest areas. Record the reason in the notes area in the data form.

GPS Offset bearing/distance: If you cannot obtain a GPS reading to map a cover type change at that location (due to satellite availability or inability to traverse dense shrubs), record the bearing (degrees) and distance (m) from the point where you could obtain a GPS coordinate to the true location of the cover type change. Procedures are described in **SOP 5**.

Veg type: Assign the cover type into one of 6 categories (H = herbaceous, S = shrub, T = tree, U = unvegetated, D = developed, E = end of transect).

Veg origin: Record if the segment is Native (N) or Exotic (E) or, in the case of a road, trail or bare ground with no vegetation, record not applicable (NA).

Herbaceous subveg origin and cover: Cover class of the exotic or native component of the vegetation; recorded for exotic species cover where nativeness = N, and for native species cover where nativeness = E.

Grazed: Record "Y" (yes) if grazed or shows evidence of rabbit burrowing activity. Record "N" (no) if not grazed.

Predom substrate: This is recorded only in segments that are unvegetated such as sand, roads or trails. Record sand, rock, gravel, log, soil or water. If a segment is vegetated (i.e., not "U") then leave this entry blank.

Notes: Observations that may be helpful later are recorded here. The species that make up the segment, fresh rabbit activity, and new disturbance of some kind are examples of helpful notes.

Page___ of ___: Be sure to fill out this section; this will be helpful when the data are entered.

When completing a transect, the field crew should review the data form to ensure that all the fields are filled out and no information is missing. At the end of the field day, data forms should be checked and compiled in a folder for processing later in the office.

Photo Documentation

Photo documentation is not required for the sampling of transects. However, if while sampling transects field personnel find that photos would be helpful, follow the guidelines in **SOP 9** for file naming convention and storage.

Cautionary Note

Cover of some native species that are encountered on the transects may be difficult to estimate. *Rubus ursinus* is often trailing under the grasses, and cover estimates may be difficult because it is hidden by other species and because a lot of the cover is due to the stems rather than leaves. *Pteridium aquilinum* is another species that may be difficult because it is taller than the other plants, and its fronds grow rapidly over the course of the summer. Due to the rapid expansion of the fronds, we try to complete all the transects within 1-2 weeks to eliminate variation between

transects based on phenology. This is also the reason that we are recording data on the bracken fern height and frond development. Observe these species carefully; often these species have a higher cover value than it may appear initially. In addition to estimating the cover, you may find that you are assigning a Native cover to a segment that is dominated by either of these species, despite the fact that there are no other natives in the segment. This is the correct answer and the modifier you assign (i.e. amount of exotic cover) will document the fact that this is a native cover type with low quality.

Camp (AC or EC): _____ **Transect**: _____

Entered by/date: _____
Updated by/date: _____
Verified by/date: _____

Start date (mm/dd/yy): ___/___/___ **Start time**: _____ **End date**: ___/___/___

Total hours spent: _____ **Observers**: _____

Transect easting (AC): _____ **Transect northing** (EC): _____ **GPS file**: _____

Weather: _____ **Event notes**: _____

Phenology:

Pteridium aquilinum: ___not visible ___emerging (fiddleheads) ___vegetative ___average height (estimate in m)
Camassia quamash: ___not visible ___vegetative ___flowering ___fruiting ___leaves senescent
Festuca roemeri: ___not visible ___vegetative ___flowering ___fruiting ___leaves senescent

Segment Number	**UTM N / E** (last 4 digits)[1]	**X** if no GPS	**GPS off-set** bearing/ distance	**Veg Type**[2]	**Veg Origin** Exotic or Native	**Herbaceous Subveg Origin & Cover**[3]	**Grazed** (Y/N)	**Predom. Substrate**	**Notes**

[1] UTM N (northing) is recorded if at American Camp and UTM E (easting) is recorded if at English Camp.
[2] Veg types: **H** = herbaceous, **S** = shrub, **T** = tree, **U** = unvegetated, **D** = developed, **E** = end of transect.
[3] Herbaceous Subveg Origin & Cover: If Veg Origin is **N**, record **E** for Subveg Origin and cover of 0-10%, 11-49%, or ≥50%. If Veg Type is **E**, record **N** for Herbaceous Subveg Origin and cover of 0-10% or 11-49%.

2012_Prairie_transect_data_form Page ____ of ____

Figure 6.1. Prairie Vegetation Monitoring Field Form: Transect Data (page 1).

Camp (AC or EC): _____ **Transect**: _____

Start date (mm/dd/yy): ___/___/___ **End date** (mm/dd/yy): ___/___/___

Entered by/date: _____
Updated by/date: _____
Verified by/date: _____

Segment Number	**UTM N / E** (last 4 digits)[1]	**X** if no GPS	**GPS off-set** bearing/ distance	**Veg Type**[2]	**Veg Origin** Exotic or Native	**Herbaceous Subveg Origin & Cover**[3]	**Grazed** (Y/N)	**Predom. Substrate**	**Notes**

[1] UTM N (northing) is recorded if at American Camp and UTM E (easting) is recorded if at English Camp.
[2] Veg types: **H** = herbaceous, **S** = shrub, **T** = tree, **U** = unvegetated, **D** = developed, **E** = end of transect.
[3] Herbaceous Subveg Origin & Cover: If Veg Origin is **N**, record **E** for Subveg Origin and cover of 0-10%, 11-49%, or ≥50%. If Veg Type is **E**, record **N** for Herbaceous Subveg Origin and cover of 0-10% or 11-49%.

2012_Prairie_transect_data_form Page ____ of ____

Figure 6.2. Prairie Vegetation Monitoring Field Form: Transect Data (page 2).

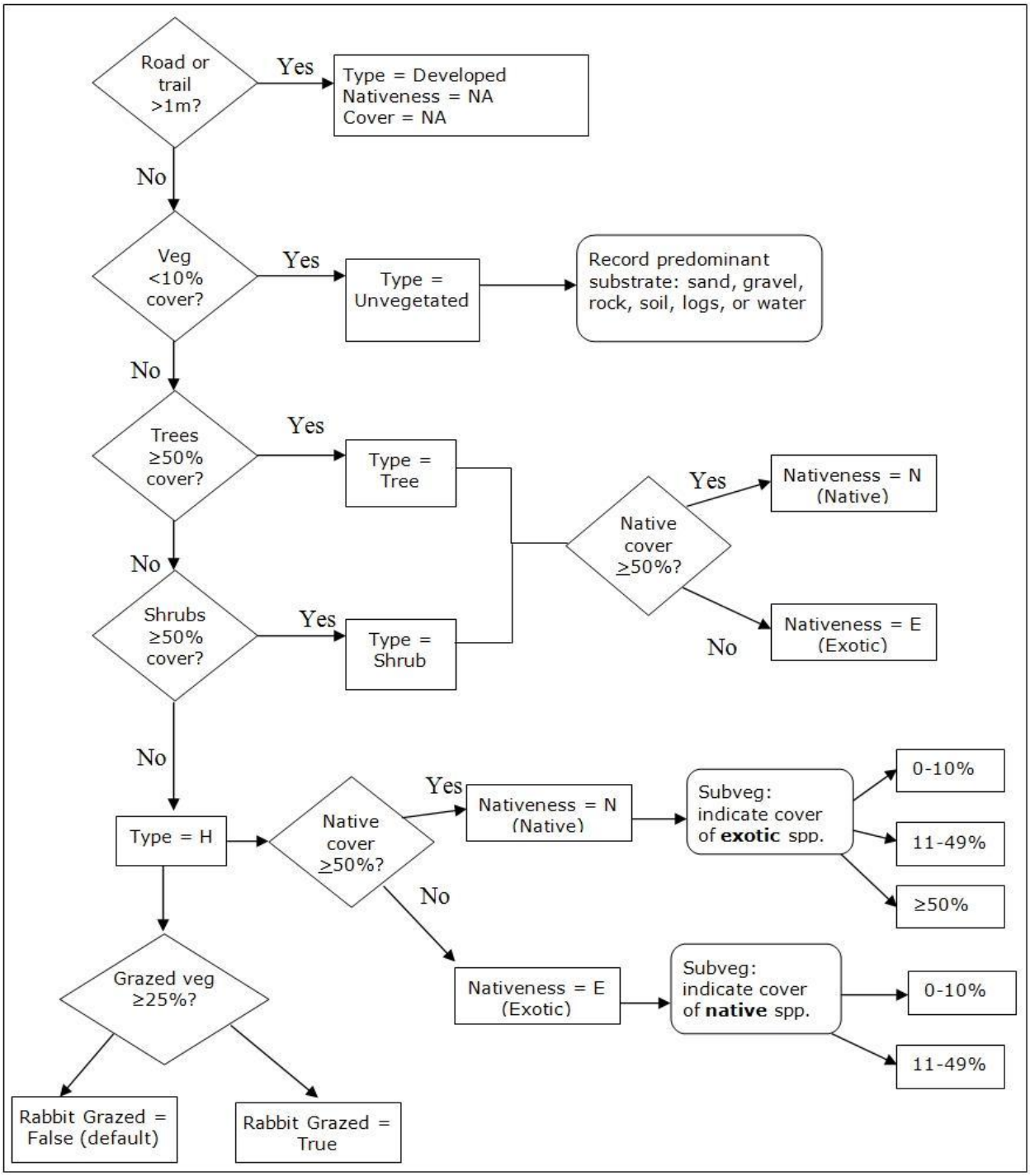


Figure 6.3. Cover type decision tree.

SOP 7: Monitoring Herbaceous Vegetation Quadrats

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP describes the methods used to monitor herbaceous vegetation within a 1 × 1-m quadrat. Quadrats will be systematically distributed along transects within two strata: exotic herbaceous vegetation and native herbaceous vegetation. Vegetation will be documented using ocular estimation to quantify cover of each species that occurs in the quadrat. The presence of each vegetation species will be recorded in one of the following cover classes: 0: no cover; 1: >0-5%, 2: >5-25%, 3: >25-50%, 4: >50-75%, 5: >75-95%, and 6: >95-100%. All vegetation species should be recorded and assigned a minimum of cover class 1 (>0-5% cover) if present in the quadrat.

Equipment Needed

- Clipboard
- Data forms printed on water proof paper (data form is presented at the end of this SOP, Figures 7.1, 7.2).
- Pencil
- GPS unit loaded with quadrat locations
- Map illustrating area and transect and quadrat locations
- SOP for quadrat monitoring
- List of quadrat locations (UTM coordinates)
- SAJH plant list
- 1 x 1 m quadrat frame
- Hand lens, ruler, plant guide
- Bag, plastic container, or plant press to collect unknown species for office review
- Safety related equipment: water, sun block, proper clothing

Office Preparation

- Load the GPS unit with the point locations for each transect (refer to NCCN Global Positioning System Data Acquisition and Processing guidance document (http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm) or the GPS user manual for instructions on transferring files from the GPS unit to a computer
- Print data forms on Rite-in-the rain and regular paper

Field Monitoring

Quadrats will be located only within the herbaceous segments of each transect; quadrats will be distributed every 35 meters (cumulative) within both native sections and exotic sections of the herbaceous vegetation.

Locating Quadrats

After the transects have been monitored, the GIS Specialist will calculate the locations for the quadrats to be monitored in the current year and post these for the Field Crew in both Excel file format and a GPS data file (SAJH_quadratYYYY.imp, where YYYY denotes the year) in the project workspace. Field Crew will load the GPS data file onto the GPS and print out the Excel file as a field hardcopy. Quadrats will be numbered according to the panel-transect naming convention, with quadrat number indicated by a suffix (e.g. 1-1.Q20 for quadrat number 20 on transect 1-1). The GPS will be used to navigate to the quadrat point, and the navigation coordinates will be recorded in the designated spaces on the field form. However, you do not need to collect new GPS coordinates because the quadrats are not permanent.

When you reach the GPS point for the quadrat, place the quadrat frame on the ground with the midpoint of the southern side of the frame on the point. The 1 m quadrat will then extend 0.5 m to each side of the transect and 1m north of the point. The next quadrat placement point will be 35 m from the last placement point, i.e. the southern edge of the quadrat frame.

Data Collection

Quadrats for each transect should be recorded on one set of data forms for each sampling date (i.e., return visits on a later date represent a separate sampling event). If you need more than one sheet for each transect, use a continuation sheet, but do not combine quadrats from multiple transects or multiple events on one sheet.

Summary Information
At the beginning of each transect sampling event you should record:

> *Camp (AC or EC): Indicate in which camp the transect is located (AC for American Camp and EC for English Camp)*
>
> *Transect*: Record the transect number in the format #-#. For example transect 5 in panel 1 is numbered 1-5
>
> *Date:* Month, day, and year; only one transect and one date should be on each data form
>
> *Observers:* First and last name of all observers present on the sampling date
>
> *Weather:* Give a general idea of the weather, sunny or cloudy, calm or windy, presence of rain, temperature range if you know it.
>
> *Transect easting or northing:* Each transect at American Camp is oriented in a north-south direction and will have only one easting; record the easting on the top of the data form. At English Camp, since transects are oriented east-west, each transect will have one northing and this should be recorded at the top of the data sheet.

Start Time: Time you start the transect

Page___ of ___: Be sure to fill out this section; this will be helpful when the data are entered.

When you finish all the quadrats along a transect you should complete the remaining summary information:

Total hours spent: Record the total time (hours) you spent monitoring the quadrats long the transect. Time should be recorded to the nearest 0.25 hours (15 minutes); be careful to exclude time spent on lunch or other breaks.

Quadrat sampling notes: The suggestions in parentheses only list quadrat placement or species identification, but insert notes on all issues or problems you encounter.

Phenological stage: After you have traversed the entire length of the transect, check the stages that you encountered for the species listed.

Data on Individual Quadrats:

Quadrat Number: Each transect will have a series of quadrat numbers 1, 2, 3, etc. Quadrat numbering is continuous and non-repeating in a given year.

Northing or Easting: Record the UTM northing coordinate for each quadrat in American Camp and the UTM easting for each quadrat at English Camp.

Exotic or Native: Record N or E for the quadrat (this assignment will be in the Excel spreadsheet and is based on your previous transect monitoring; do not change it if you think the quadrat should have been recorded as the opposite from its assignment).

Percent Cover: Record the percent cover for the three broad cover types – Vascular vegetation, Non-vascular vegetation, and Unvegetated.

Species cover: Estimate and record using one of seven cover classes: **0**: no cover; **1**: >0-5%, **2**: >5-25%, **3**: >25-50%, **4**: >50-75%, **5**: >75-95%, and **6**: >95-100%.

The following three items will be filled in as the data is entered in the database, after the crew returns to the office:

Entered by/date: _____: Initials and date to indicate when and by whom the data were entered into the database (office only)

Updated by/date: _____: Initials and date to indicate when and by whom the field data were updated after returning from the field (office only)

Verified by/date: _____: Initials and date to indicate when and by whom the data were verified for accuracy in the database (office only)

The first step in quadrat monitoring is to estimate three broad categories of cover: Total Vascular Vegetation, Total Non-vascular Vegetation, and Unvegetated surfaces. These three categories are

used to provide a general description of the quadrat so, you should evaluate cover standing over the quadrat and looking down. Estimate cover of all vegetation and substrate that is found within the quadrat; vegetation that overhangs the frame into the quadrat should be included in your cover estimates. Rocks, bare soil, litter, or pebbles all comprise the "unvegetated" category. Litter is defined as dead plant material that is on ground; dead leaves that are still attached to a grass tussock will be estimated as live grass. Since this is a surface view of the quadrat, don't move any vegetation to estimate cover. For example, if there is a rock that is partially covered with moss, the moss covered portion is classified as Non-vascular Vegetation and the exposed is classified as Unvegetated.

Cover of individual species is estimated by standing over the quadrat frame, listing all the species within the quadrat and then estimating the cover of each species. In this case, you can move vegetation to see what is beneath other species because you will be recording species in several canopy layers. Cover classes can add up to more than 100% cover because there are several canopy layers and because the cover classes are broad. If you encounter a species in quadrat 1 that is not in quadrat 2, be sure to put a 0 in the row for quadrat 2 so we are certain that the species did not occur in that quadrat (i.e. and not that someone forgot to look for it).

Optional Photos

Although this protocol does not have a defined set of permanent photopoints, photographs of characteristic native or exotic quadrats or landscape views of typical cover types will be helpful for outreach or in the future for managers. If you take these photos, refer to **SOP 9** for labeling and storage guidelines.

Camp (AC or EC): _____ **Transect**: _____

Date (mm/dd/yy): _____ **Observers**: _____

Weather: _____

Entered by/date: _____
Updated by/date: _____
Verified by/date: _____

Transect easting (AC): _____ **Transect northing** (EC): _____

Start time: _____ **Total hours spent:** _____

Quadrat sampling notes (Did you encounter any problems with quadrat location? Did you encounter problems with species identification?) _____

_____

Check the phenological stage of:

Teesdalia nudicaulis: ___not visible ___vegetative ___flowering ___fruiting ___leaves senescent
Camassia quamash: ___not visible ___vegetative ___flowering ___fruiting ___leaves senescent
Festuca roemeri: ___not visible ___vegetative ___flowering ___fruiting ___leaves senescent

Quadrat Number													
Northing (AC)													
Easting (EC)													
Exotic or Native quadrat													
Percent Cover													
Vascular vegetation													
Non-vascular vegetation													
Unvegetated													
Species	**Cover Class Value[1]**												

[1]Cover Classes: **0**: no cover; **1**: >0-5%, **2**: >5-25%, **3**: >25-50%, **4**: >50-75%, **5**: >75-95%, and **6**: >95-100%.

Figure 7.1. Prairie Vegetation Monitoring Field Form: Quadrat Data (page 1).

Camp (AC or EC): _____ **Transect**: _____

Date (mm/dd/yy): _____

Entered by/date: _____
Updated by/date: _____
Verified by/date: _____

Species	Cover Class Value[1]												

[1]Cover Classes: **0**: no cover; **1**: >0-5%, **2**: >5-25%, **3**: >25-50%, **4**: >50-75%, **5**: >75-95%, and **6**: >95-100%

Figure 7.2. Prairie Veetation Monitoring Field Form: Quadrat Data (page 2).

SOP 8: Procedures Following a Field Tour

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP outlines the procedures to be conducted following a field tour. These procedures are carried out directly upon returning from the field. The responsibilities are described in detail below.

Crew Tasks

Crew members are to complete the following tasks at the end of the field tour. Office time will be limited and there will be much to do, so it is imperative that the crew plan ahead and work efficiently. Also remember to be considerate of others sharing the same building. Work quietly and keep gear and paperwork organized.

1. Check in. Upon return, check in with the dispatch/communication center to let them know that you are back from the field. A radio call-in at the trailhead may be sufficient. Check in is only necessary in parks where crews are in communication with dispatch and/or required to send a wilderness itinerary.
2. Meet with supervisor. Meet with your supervisor to discuss how the tour went, any issues that came up, and how they can be addressed. If any additional training is needed, or any questions arise about procedures, let the supervisor know as soon as possible. Report the number of hours worked.
3. Check work e-mail. Read messages from supervisor and Project Lead.
4. Photocopy. Photocopy or scan all data forms. File originals in their respective folders for later data entry. Scanned copies are maintained in the project workspace in a sub-folder for scanned field forms within the crew folder for the year. Photocopies can be kept in a second building (agreed upon by your supervisor), to protect the information from mishaps such as fire.
5. Batteries. Recharge, replace, and/or dispose of batteries as described in **SOP 3: Orientation and Training of Field Crews**. Make sure that there will be two good sets ready for the field the following tour for the camera, laser range finder, GPS (if required), and any other battery-operated equipment.
6. Gear. Return gear to field box. Address any gear maintenance issues.
7. Vehicle. Clean out and gas the vehicle. Address any vehicle issues. Wash the vehicle if dirty, but not more than once per month.

8. Return keys. Always return vehicle keys to the key drawer or key board as specified by the supervisor.
9. Photos. Download and name the photo images as outlined in **SOP 9: Managing Photographic Images**.
10. GPS. Download transect cover type GPS data and save in the \Rover_files\Raw folder of the project workspace for the GIS Specialist. Recharge the battery.
11. Data entry. Enter data into the project database, and verify correct transcription of data into the database. The front-end database application is found in a subfolder of the seasonal workspace. Refer to **SOP 10: Data Entry and Verification**.
12. Prepare for next tour. If all tasks are complete, begin preparations for the next tour. Check that data forms and maps are all present and ready to go.

Trip Report

During the office day the Crew Lead should write a report summarizing tasks completed in the field and issues that need to be addressed immediately or in the future. Writing the report should take less than one hour. A trip report is very helpful for trying to piece together what happened on a tour at some time in the future. The report should include:

1. Dates and locations
2. Crew members
3. What was done
4. What was not done
5. Expected or unexpected problems
6. Interesting observations.

SOP 9: Managing Photographic Images

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP describes procedures for downloading, processing and naming photographic images collected by project staff or volunteers during the course of conducting project-related activities. Images that are acquired by other means – e.g., downloaded from a website or those taken by a cooperating researcher – are not project records and should be stored separately and named in such a way that they can be readily identified as non-NPS images and not be mistaken for project records.

To effectively manage potentially hundreds of images requires a consistent method for downloading, naming, editing and documenting. The general process for managing project images is as follows:

1. Prepare image workspace – set up the file organization for images prior to acquisition.
2. Acquire images.
3. Download and process.
    a. Download the files from the camera
    b. Rename the image files according to convention detailed below
    c. Copy and store the original, unedited versions
    d. Review and edit the photos; delete unneeded or poor quality photos
    e. Move into appropriate folders for storage
4. Deliver image files for final storage.

Data Photos Defined

Care should be taken to distinguish data photographs from incidental or opportunistic photographs taken by project staff. Data photographs are those taken for the following reasons:

- To document a particular feature or perspective for the purpose of site relocation
- To capture site characteristics and to document gross structural and compositional changes over time
- To document a species detection that is also recorded in the data.

Data photographs are often linked to specific records within the database, and are stored in a manner that permits the preservation of those database links. Other photographs – e.g., showing

field crew members at work, or documenting the morphology of a particular species – may also be retained but are not necessarily linked with database records.

Image Workspace Setup

Prior to each season, the Project Lead (or a designee) should create a new set of image folders under the new season year under the Images section of the project workspace and seasonal workspaces (refer to **SOP 1: Project Workspace and Records Management**). The workspace subfolders are as follows:

[Year]	The appropriate year – 2011, 2012, etc.
[Park code]	
1_Originals	Unedited versions of image files
[Download date]	Arranged by download date to preserve file names
2_Processing	Temporary processing workspace
[Transect ID]	Arranged by transect, for images taken at a transect/quadrat
[Capture date]	Arranged by date, for images not taken at a transect/quadrat
3_Data	Data images for photos at plots
[Transect ID]	Arranged in subfolders by transect
4_Miscellaneous	Non-data images taken by project staff
[Transect ID]	Arranged by transect, for images taken at a transect/quadrat
[Capture date]	Arranged by date, for images not taken at a transect/quadrat
5_Not_NPS	Images acquired from other sources

This folder structure permits data images to be stored and managed separately from non-record and miscellaneous images collected during the course of the project. This structure also provides separate space for image processing and storage of originals. For additional information about the project workspace, refer to **SOP 1: Project Workspace and Records Management**.

In all cases, folder names should follow these guidelines:

- No spaces or special characters in the folder name.
- Use the underbar ("_") character to separate words in folder names.
- Try to limit folder names to 20 characters or fewer.
- Date names should be formatted as YYYYMMDD.
- Transect folder names are typically a four- or five-character string with the underbar character separating the unit and panel from the one- or two-digit plot number (e.g., A3_1 for panel 3, transect one in American Camp).

Image Acquisition Standards

Capture images at an appropriate resolution that balances space limitations with the intended use of the images. Although photographs taken to facilitate future navigation to the site do not need to be stored at the same resolution as those that may be used to indicate gross environmental change at the site, it may be more efficient to capture all images at the same resolution initially. A recommended minimum raw resolution is 1600 x 1200 pixels (approximately 2 megapixels). Higher resolutions may be available but are undesirable from the perspective of data storage and information content.

Download and Processing Procedures

1. Under the appropriate "Originals" subfolder, create a subfolder for the download date (e.g., 20120615). Other suffixes may be used to distinguish downloads when multiple sites or parks are downloaded on the same date.
2. Download the raw, unedited images from the camera into the new subfolder. Depending on the operating system used by the person downloading, it may be possible to greatly reduce the time and effort it takes to rename the images in subsequent steps.
   - Plug in the camera to the USB port and turn the camera on.
   - From the Start menu, select All Programs > Accessories > Scanner and Camera Wizard (or select this option if a dialog box appears upon plugging in the camera).
   - Follow screen prompts until reaching the 'Picture Name and Destination' screen. You will be able to select name prefix/suffix, image format, and photo destination.
     - For name prefix, use the naming conventions indicated later in this SOP.
     - For image file format, select the default (JPG).
     - For photo destination, browse to the appropriate "Originals" subfolder.
3. Copy the images to the "Processing" folder and set the contents under "Originals" as read-only by right clicking in Windows Explorer and checking the appropriate box. These originals serve as backups in case of unintended file alterations (e.g., incorrect names applied, file deletion, loss of resolution, or loss of image metadata upon rotation).
4. Finish renaming the images in the "Processing" folder according to convention (refer to the image naming standards section).
   - If image file names were noted on the field data forms, be sure to update these to reflect the new image file name prior to data entry. Field form annotations should be done in a different color ink from the original notation, after first drawing a line through the original entry (for more information, refer to **Section 4D, Data Entry and Processing**).
   - Renaming may be most efficiently done as a batch using image processing software such as Microsoft Office Picture Manager, which allows a standard prefix or suffix to be added to the camera file name. After batch renaming, a descriptive component may be added manually to each file name.
5. Process the images in the "Processing" folder, using the edit features built into image software programs such as ThumbsPlus or Microsoft Office Picture Manager. At a minimum, the following processing steps should be performed on all image files:
   - Delete photographs of poor quality – e.g., out of focus, poor light levels, etc. Low quality photographs might be retained if the subject is highly unique, or the photo is an irreplaceable data photo.
   - Duplicates should also be deleted unless they provide unique information. Other non-data photographs should be evaluated for their potential long-term value.
   - Rotate images to make the horizon level.
   - Remove 'red eye' glare in photographs of people.
   - Crop non-data images to remove edge areas that grossly distract from the subject.
6. Optional processing steps may include enhancing contrast or brightness, or resizing images to make them small enough for use in documents or on the web. These steps are not recommended for data photos.

7. When finished processing the current download, move the image files that are to be retained to the appropriate folder – i.e., data images to the appropriate "Data" subfolder, other images under the appropriate "Miscellaneous" folder.
8. Photos of potential interest to a greater audience should be uploaded to the NCCN Digital Library.
9. Delete files from the "Processing" folder between downloads to minimize the chance for accidental deletion or overwriting of needed files.

Image File Naming Standards

In all cases, image names should follow these guidelines:

- No spaces or special characters in the file name.
- Use the underbar ("_") character to separate file name components.
- Try to limit file names to 30 characters or fewer, up to a maximum of 50 characters.
- Park code and year should either be included in the file name (preferred), or specified by parent folders in the directory structure.
- Dates should be formatted as YYYYMMDD (this leads to better sorting than other date naming conventions).

The image file name should consist of the following parts, separated by an underbar character:

1. The date on which the image was taken (formatted as YYYYMMDD)
2. The four-character park code (SAJH)
3. Two-character code for park sub-unit (AC for American Camp, EC for English Camp)
4. Image location code (transect ID and quadrat number formatted as "Qxx" where xx denotes 2-digit quadrat number, separated by an underbar)
5. Optional: a brief descriptive word or phrase
6. Optional: a sequential number if multiple images were captured
7. Optional: time (formatted as HHMM)

Examples:

- 20120612_SAJH_AC_1-13_Q07_H.jpg — Quadrat #7 on annual transect #13 at American Camp, taken on June 12, 2012
- 20120518_SAJH_EC_training_4.jpg — 4th photo taken during training at SAJH (English Camp) on May 18, 2012

Post-season Cleanup Procedures

At the end of the season, field crew members should organize images within the seasonal workspace and notify the Project Lead, after making sure that all processing folders are empty. For crew members stationed at remote parks who need to work on local copies, a CD or DVD should be prepared and delivered to the Project Lead.

After each season, the Project Lead (or a designee) should:

1. Review the seasonal workspace folders to make sure that all images are properly named, filed, and accounted for.
2. The 'Processing' folder should be empty and may be deleted.

3. Files in the 'Not_NPS' folder may be refiled as appropriate.
4. The contents of the 'Originals' folder may be deleted once all desired files are accounted for. Originals of data images may be retained as desired, depending on the size of the files and storage limitations. If storage space is limiting, originals may be stored on a local hard drive or external drive.
5. Copy the entire contents of the 'Images' subfolder from the seasonal workspace to the main project workspace, and delete the images subfolders from the seasonal workspace.
6. Set the images in the project workspace to read-only to prevent unintended changes.

SOP 10: Data Entry and Verification

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP describes the general procedures for entry and verification of field data in the project database application. For related guidance, refer to **Section 4C, Overview of Database Design**, and **Section 4D, Data Entry and Processing**. The following are general guidelines:

1. Data should be entered as soon after data collection as possible so that field crews remain current with data entry tasks, and identify any errors or problems as close to the time of data collection as possible.
2. The front-end database application is a Microsoft Access file maintained in the project workspace (see **SOP 1: Project Workspace and Records Management**). This front-end copy may be considered "disposable" because it does not contain any data, but rather acts as an interface with data residing in the back-end database. It contains the forms, queries, and formatted report objects for interacting with the data in the back-end.
3. The back-end database for this project is implemented in Microsoft SQL Server to take advantage of the automated backup and transaction logging capabilities of this enterprise database software.
4. Each data entry form is patterned after the layout of the field form, and has built-in quality assurance components such as pick lists and validation rules to test for missing data or illogical combinations. Although the database permits users to view the raw data tables and other database objects, users are strongly encouraged only to use the pre-built forms as a way of ensuring the maximum level of quality assurance.
5. As data are being entered, the person entering the data should visually review each data form to make sure that the data on screen match the field forms. This should either be done for each record prior to moving to the next form for data entry, or preferably as a separate step after all of the data for a sampling trip has been entered. Important: It is a requirement that all events must be entered and verified at the end of the field season.
6. At regular intervals and at the end of the field season the Crew Lead should inspect the data that have been entered to check for completeness and perhaps identify avoidable errors. The Crew Lead may also periodically run the Quality Assurance Tools that are built into the front-end application to check for logical inconsistencies and data outliers (this step is described in greater detail in **Section 4E, Data Quality Review** and also in **SOP 12: Data Quality Review and Certification**).

Database Instructions

Getting Started

The first action to be taken is to make sure the project workspace is set up properly on a networked drive. Refer to **SOP 1: Project Workspace and Records Management** for instructions on how to set up and access the project workspace.

Important Reminders for Daily Database Use

- If accessing the database from a remote park (i.e., other than OLYM), do not open and use the front-end application outside the remote desktop environment as it will run very slowly and likely stall. Instead, refer to the following instructions on remote access before using the application.
- If accessing the database from OLYM, do not open and use the front-end application on the network as this makes it run more slowly. Instead, copy the front-end file from the project workspace to your local desktop and open it there. This copy can be replaced with new versions as they are released.
- New versions of the front-end application may be released as needed through the course of the field season. When this happens, you may see a notification about a new release when opening the current or older versions of the front-end. Copies of the outdated version of the front-end file should be deleted and replaced with the new version, which will be named in a manner reflecting the update (e.g., Prairie_Veg_2012_v2.mdb).
- Upon opening the front-end application for the first time, there may be a need to reconnect the front-end to the back-end, depending on how the project workspace is mapped on your computer. This database connection update should only need to be done once for each new release of the front-end database.

Remote Connections for Data Entry and Database Access

Most of our project databases are hosted on a server at OLYM. Due to bandwidth limitations, project database users accessing these databases from other parks (or from remote locations at OLYM) may encounter slow performance or application errors when accessing the database directly via a networked drive or a local front-end file. Therefore, to make data entry as smooth and efficient as possible, such users will typically need to use a remote desktop connection each time they need to access the database.

Remote desktop connections access what is called a “terminal server” at OLYM. In doing so, all of the processing is occurring on a server collocated with the database server, thus minimizing the negative effects of bandwidth on application performance. Through such a connection, the remote user is essentially sending mouse moves and keystrokes to the terminal server, and receiving screen updates in return. There may be some noticeable lag time in mouse moves and screen updates, but the performance is often much better than when accessing the data through other means.

Instructions for Using Remote Desktop

1. From the Start menu, go to: All Programs > Accessories > Communications > Remote Desktop Connection. You may wish to create a desktop shortcut by right clicking on the Remote Desktop Connection icon in the menu and selecting Send To > Desktop.
2. With the Remote Desktop window open, type in the terminal server name: "inpolymts1".

3. Click on the Connect button.
4. Enter your NPS login and password. Note that the login must be preceded by "NPS\", for example: "NPS\gwashington".
5. The remote desktop session will open and you will see a blank desktop that represents what you would see if you were sitting at the computer at OLYM. The first time you use it you may need to map network drives you use frequently and create other useful shortcuts (e.g., to the project workspace), and you will need to use the Access 2010 first-time setup instructions (see the following section) so that the project database functions properly. These initial setup steps should only need to be done once, however.
6. You may switch back and forth between your remote session and your local session (i.e., on your local workstation) using the connection bar across the top of the remote desktop screen.
7. When using the project database, you may need to make a copy of the front-end application if someone else is already using the file (evidenced by a ".ldb" lock file with the same name and in the same folder as the front-end file). You may also want to create your own subfolder in the project workspace for your own front-end copy to avoid these conflicts with other users.
8. When you are finished with your remote session, log off by clicking on Start > Log Off.

The first time you use Remote Desktop, you may wish to select Options from the first Remote Desktop Connection screen to enter more specific information for your frequent remote desktop sessions (e.g., enter "inpolymts1" for the computer, your NPS login, and "NPS" for the domain so you don't have to enter "NPS\" in front of your login each time). Do NOT enter your password or check the box to save your password, as this may present a security risk.

Special Instructions for Access 2010

If you are going to be using Access 2010, make sure the security settings will allow the database to function properly. This is necessary because Access 2010 may have been installed in a very restrictive security mode that disables the functionality built into the project database. Note: This setting change should only need to be performed once. However, if you move to a different workstation, these steps may need to be repeated to allow the database to perform properly. You will know the difference if none of the buttons or form functions on the main database switchboard form work properly, or if you get the following warning message across the top of the window:

To enable the database content to run properly on a consistent basis, do the following:

1. Prior to using the front-end database, open Access 2010 from the Start menu.
2. Go to Start > All Programs > Microsoft Office > Microsoft Office Access 2010.
3. In the upper left corner, click on the Office Button.
4. At the bottom of the menu page, click the Access Options button.
5. Select the Trust Center category on the left panel.
6. In the lower right, click the Trust Center Settings button.
7. Select the Macro Settings category on the left panel.
8. Select the option "Enable all macros". Then hit OK, and exit Access.
9. From this point forward the project database application should function properly on that computer.

User Roles and Privileges

The database application provides different levels of access privileges: read-only, data entry, power user, and administrator. These privileges are assigned based on user login by the Project Lead or a designee at the beginning of each field season. Most field crew users will be granted "data entry" rights, which allow one to enter and edit data for the current field season only. Certified data and lookup domains may only be edited by users with power user or administrator privileges. If a user name is not granted explicit rights to the database, the application will open in "read-only" mode.

Overview of Database Components

The front-end application has multiple functional components, which are accessed from the main application switchboard form that opens automatically when the application starts. Several buttons are found on the form to provide access to different components of the application, and are arranged in functional categories:

- Data Entry and Edits
    - Enter / edit data – Opens a form to confirm default settings (e.g., park, coordinate datum) prior to continuing to the project-specific data entry screens.

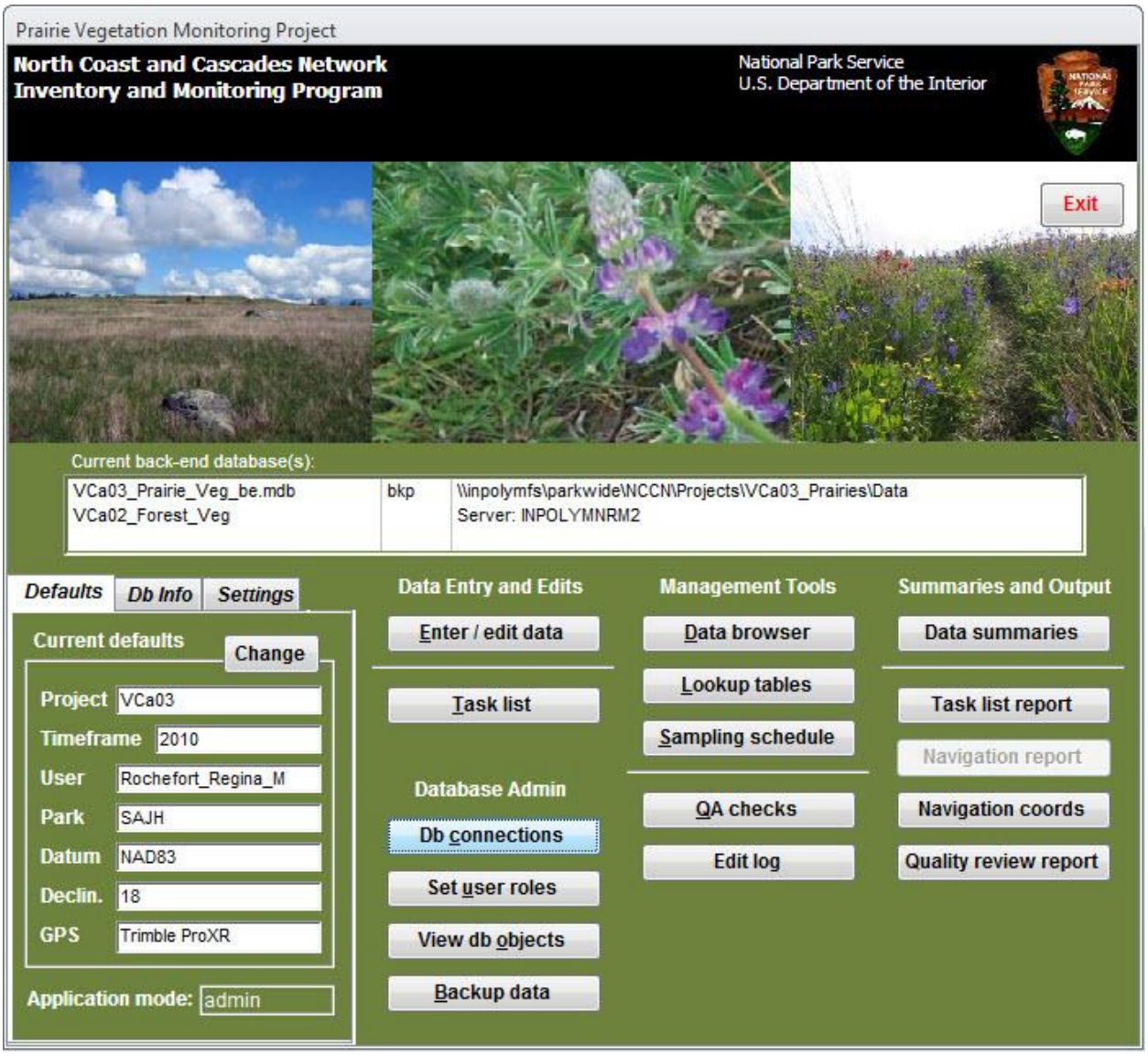
  - Task list – Keeps track of unfinished tasks associated with sample locations (for example, forgotten equipment, unfinished data collection) that one field crew can use to communicate with a future field crew.

- Database Admin
  - Db connections – Manage and update the connections to the back-end database(s).
  - Set user roles – Manage the list of users who may view, enter and edit the database. Provides four levels of access: read-only, data entry, power user, and admin. This button is only enabled for power users and administrators.
  - View db objects – Allows the user to view and edit database objects (tables, queries and forms). This button is only enabled for power users and administrators.
  - Backup data – Makes a zipped copy of the back-end file and stores this backup in a subfolder. This button is visible only when one or more of the back-end databases is implemented in Microsoft Access.

- Management Tools
  - Data browser – Opens a tabbed form that provides comprehensive access to data arranged by sampling location. This form has headers for filtering by park, location code, location type and status.
  - Lookup tables – Opens a tool for managing the lookup values for the project data set (e.g., species list, list of project personnel).
  - Sampling schedule – Opens a form to view and edit the sampling schedule.
  - QA checks – Opens the data validation and quality review tool, which shows the results of pre-built queries that check for data integrity, missing data, and illogical values, and allows the user to fix these problems and document the fixes. See **SOP 12: Data Quality Review and Certification**.
  - Edit log – Opens a form for documenting edits to certified data records.

- Summaries and Output
  - Data summaries – Opens a form for viewing and exporting summary queries for data exploration, analysis and reporting.
  - Task list report – Generates a report of tasks that need to be accomplished for a specified park or sample location (default is for all locations).
  - Quality review report – Generates the data quality review results for a selected year or all years.
  - Navigation report – Generates the field season Navigation Report used to relocate sample locations and brief the crew on tasks that need to be accomplished.
  - Navigation coords – Provides current, best navigation target coordinates for sample locations so these can be loaded into GPS units for navigation, or GIS for display and map production.

Below is a view of the main startup menu / switchboard form.



The lower left portion of the main startup menu has tabs for user defaults, database version release information, and run-time settings.

- Defaults – Default values for the application. User name, park, datum, declination, and GPS model type can all be changed by the user. To change user defaults, click on the 'Change' button. This will open up a new window where the user can update the default values. This window also appears each time the user selects the path for data entry or review to ensure that the correct user and park are indicated.
- Db Info – Contains the release information, technical support contact information, and buttons for reporting a bug or issue.
- Settings – Contains checkboxes for run-time application settings:
    - Prompt for backup on startup – The user will be prompted to make a data backup when the application opens.

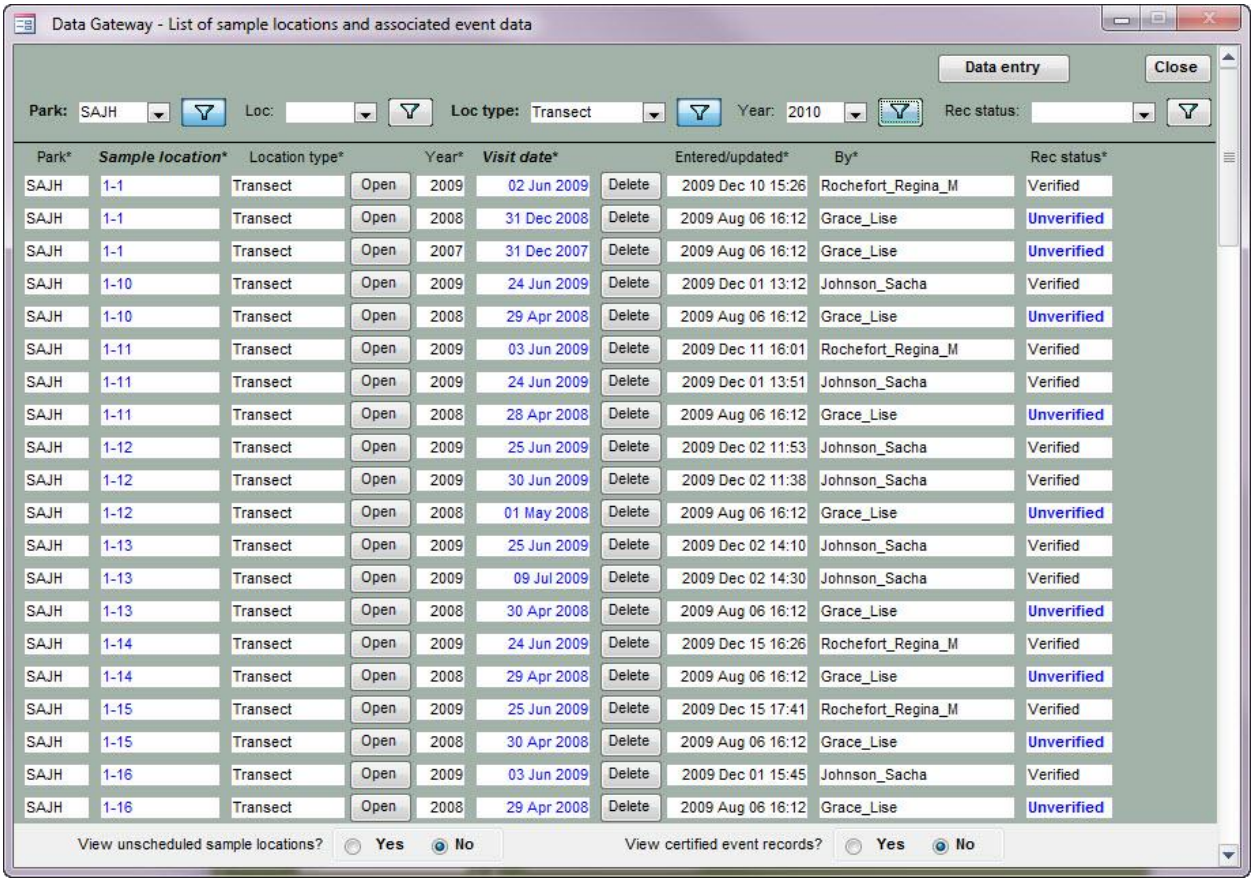
- Prompt for backup on exit – The user will be prompted to make a data backup when the application closes. Default is on, which means that the user will be prompted each time the application closes if there is at least one Access back-end for which backups are specified.
- Compact back-end on exit – Compacts the back-end database when the application closes. This helps to manage the size of the back-end, which improves performance over the network.
- Test all connections on startup – Ensures that each of the back-end tables is linked properly. Default is on, which means that the user will be prompted on startup if there is at least one Access back-end.

Entering and Verifying Event Data

When you select the "Enter / edit data" button, you will have a chance to change the default user name, park, datum, declination, and GPS model. Make sure this information is correct each time you enter data. Note: These defaults are properties of the front-end application, so different users reusing the same front-end file will need to change this information frequently. To avoid this, make copies of the front-end file for each user.

Data Gateway Form

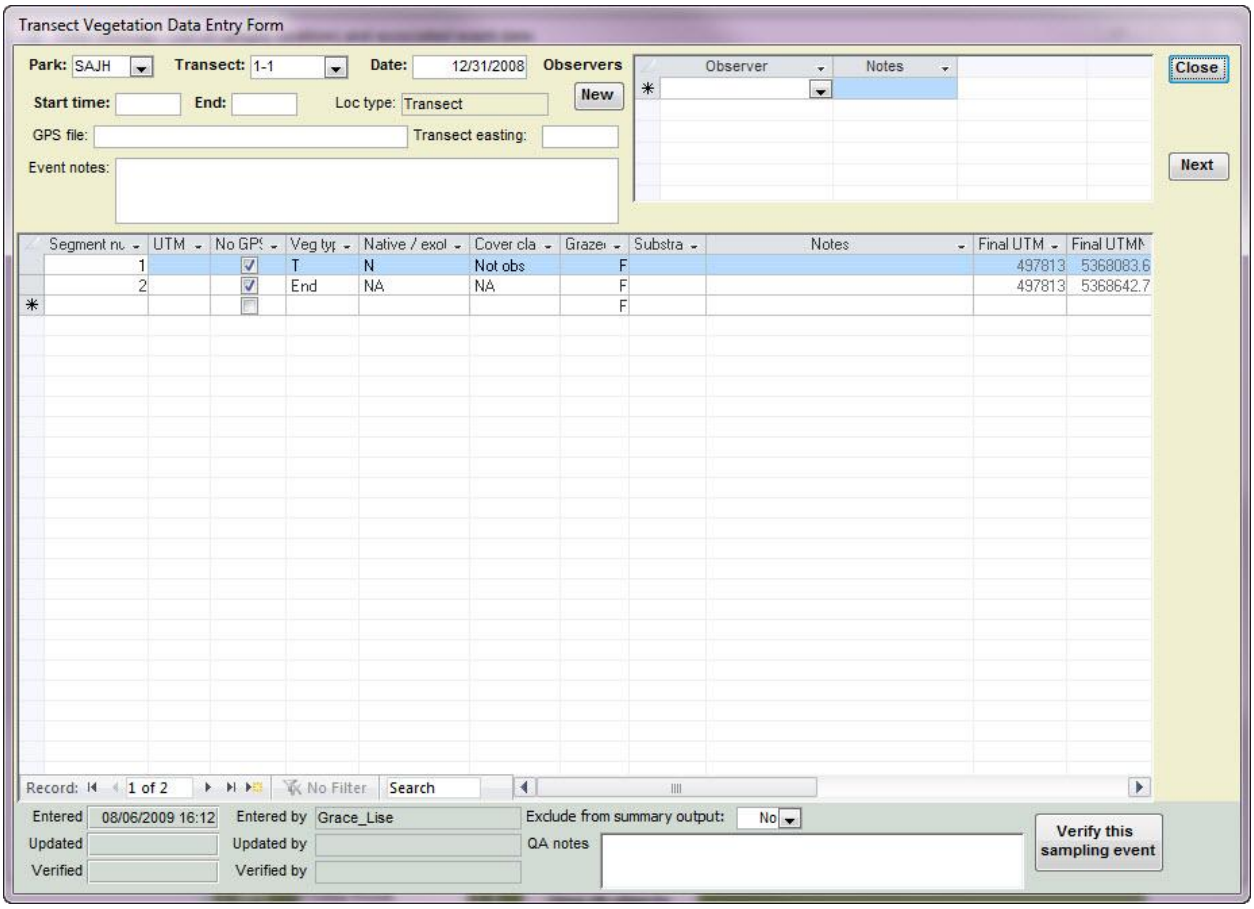
Next you will see the Data Gateway Form, which is where you will see a list of sample locations that are already present in the back-end database. This list is automatically filtered by the selected park (upper left corner), and to show only scheduled sample locations for the current sampling year. There is also the capability to filter by park, sample location, location type (reconnaissance vs. monitoring), sampling event year, and record status. Filters can be changed at any time, and records can be sorted by double-clicking on the field label above each column.



At the bottom of the form are radio buttons to allow the user to view unscheduled sampling locations if needed (e.g., an unscheduled site was visited after the sampling plan was made at the beginning of the season). Another set of radio buttons allows the user to view certified records from previous seasons (power users only).

Data Entry Form

To access this form from the Data Gateway Form, either click on the "Open" button associated with the desired record, or double-click on the "Sample location" cell, or on the "Visit date" cell. Any of these options will pre-populate the form with existing information. To open the Data Entry Form to a new record, click the "Data entry" button at the upper right of the Data Gateway Form.



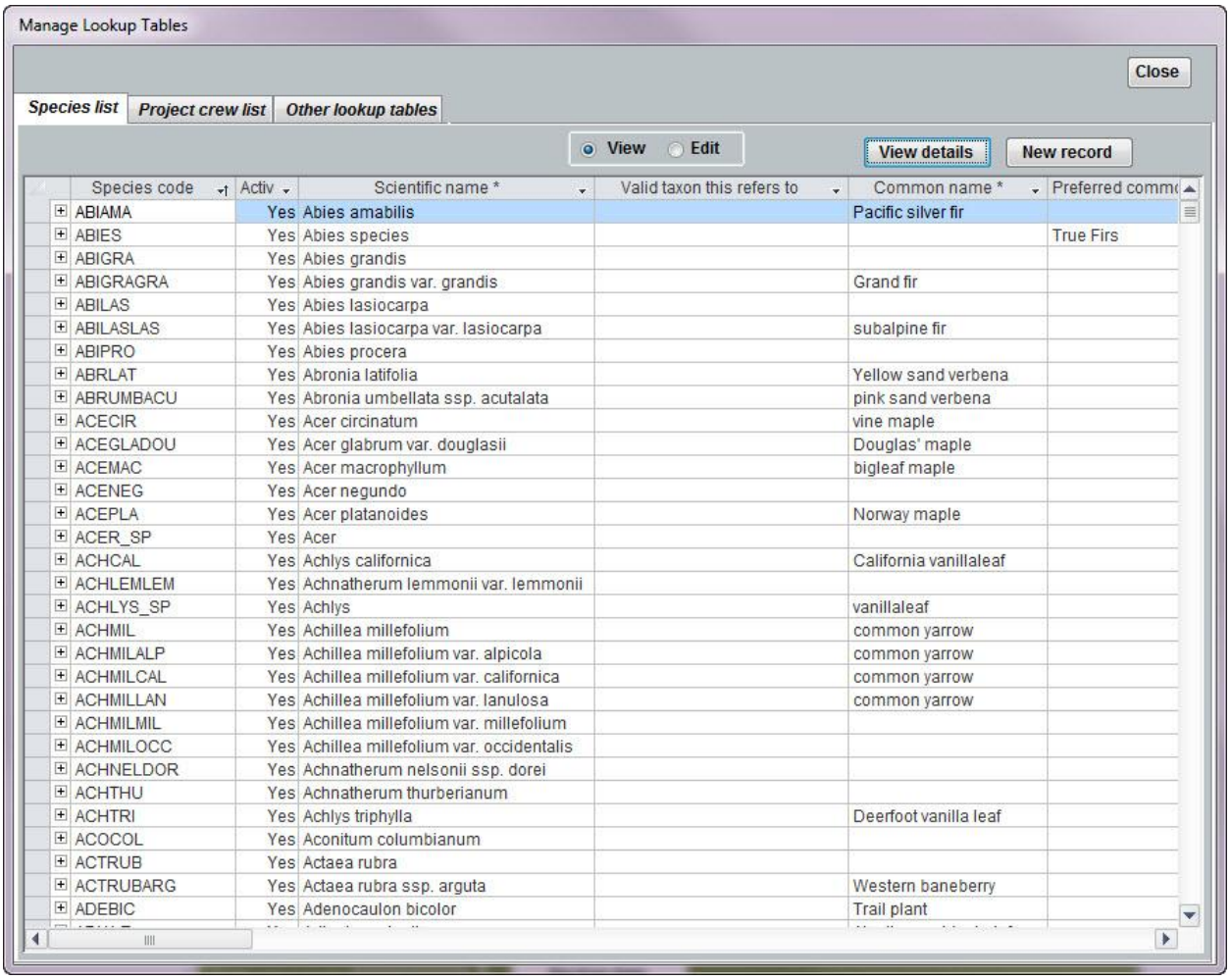
Verifying Data Records

Field crews must verify all sampling events throughout the field season. The recommended approach is for one crew member to do all of the data entry for one sample location, then have another crew member review and verify records for that location. The current record status for each sampling event is shown in the Data Gateway Form. To see all of the sampling events in the database, be sure to turn off the filters to show all of the sampling points and events. By double-clicking on the record status field in the Data Gateway Form, the appropriate data entry form will be opened for verification.

To complete the verification step: After all data for a given transect have been entered completely, the database entries should be compared against the original field forms. Each of the main data entry screens has a footer containing fields for storing quality assurance information about the event, and information on who created the sampling event record, who last updated it, etc. When all data for the sampling location have been verified, click on the button that says "Verify this sampling event" to indicate that the event record is complete and accurately reflects the field forms. Clicking this button instantly updates the record status in the Data Gateway for that sampling event. Remember that both transect and quadrat data will need to be verified before clicking the "Verify" button on the main Data Entry form.

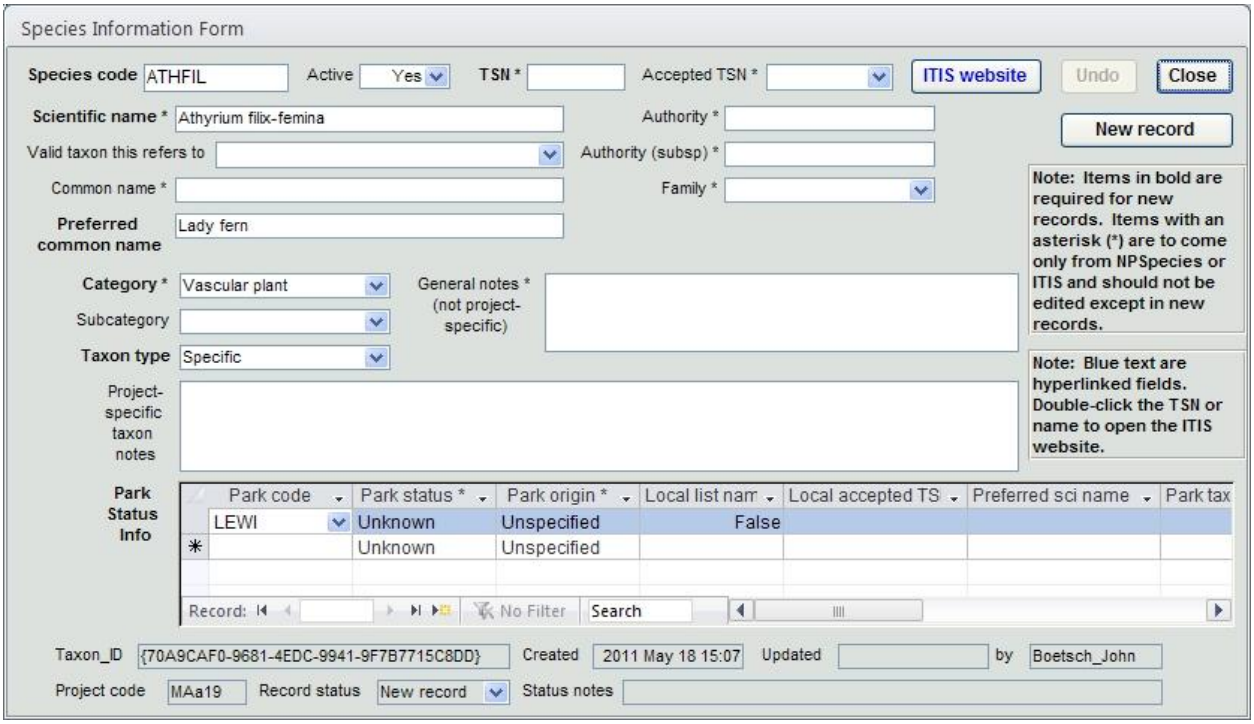
Manage Lookup Tables

From the main startup menu, click on 'Lookup tables' to open the Manage Lookup Tables Form. This form has three tabs – one for the project species list, another for the project crew list, and a third for viewing the contents of all other lookup tables. Minor edits may be made on the species list tab by putting the form into Edit mode. By selecting a record and clicking on "View details", or by double-clicking on any record selector (the gray box to the left of each record), the Species Information Form will open. To add a new record click on 'New record'.

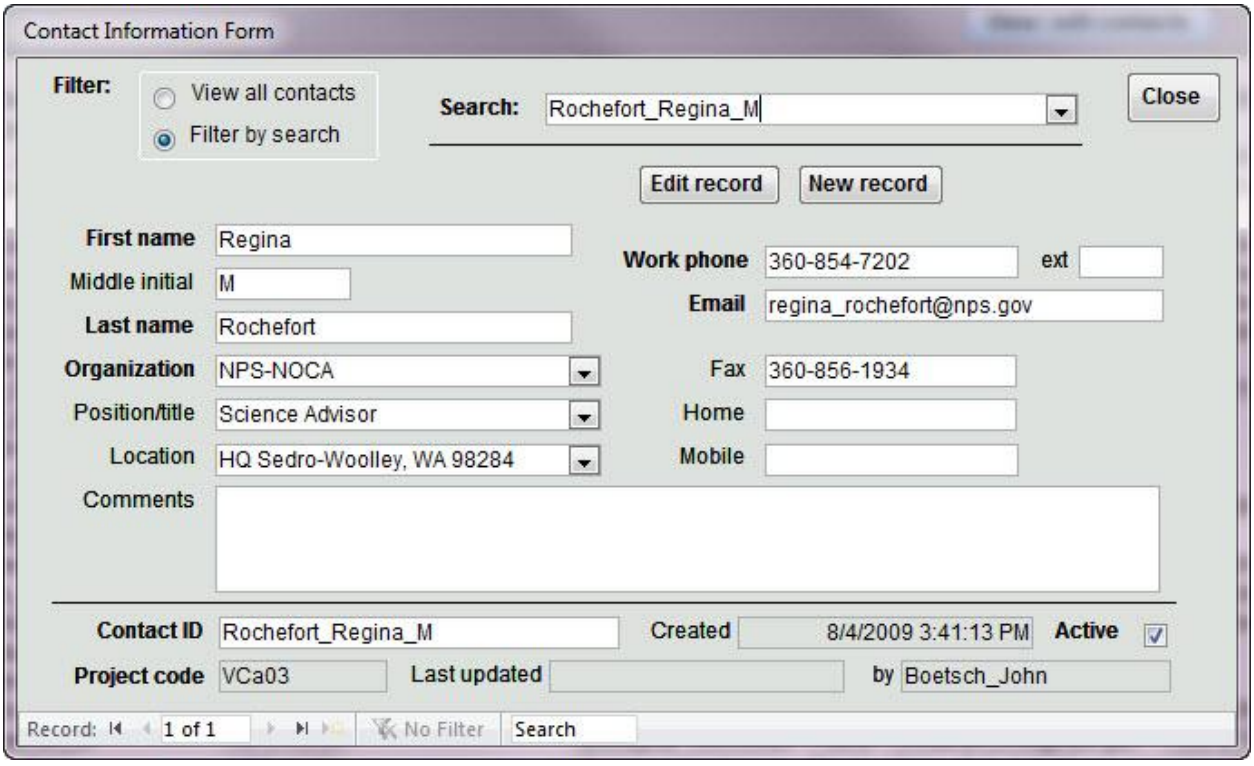


Species code	Activ	Scientific name *	Valid taxon this refers to	Common name *	Preferred comm
ABIAMA	Yes	Abies amabilis		Pacific silver fir	
ABIES	Yes	Abies species			True Firs
ABIGRA	Yes	Abies grandis			
ABIGRAGRA	Yes	Abies grandis var. grandis		Grand fir	
ABILAS	Yes	Abies lasiocarpa			
ABILASLAS	Yes	Abies lasiocarpa var. lasiocarpa		subalpine fir	
ABIPRO	Yes	Abies procera			
ABRLAT	Yes	Abronia latifolia		Yellow sand verbena	
ABRUMBACU	Yes	Abronia umbellata ssp. acutalata		pink sand verbena	
ACECIR	Yes	Acer circinatum		vine maple	
ACEGLADOU	Yes	Acer glabrum var. douglasii		Douglas' maple	
ACEMAC	Yes	Acer macrophyllum		bigleaf maple	
ACENEG	Yes	Acer negundo			
ACEPLA	Yes	Acer platanoides		Norway maple	
ACER_SP	Yes	Acer			
ACHCAL	Yes	Achlys californica		California vanillaleaf	
ACHLEMLEM	Yes	Achnatherum lemmonii var. lemmonii			
ACHLYS_SP	Yes	Achlys		vanillaleaf	
ACHMIL	Yes	Achillea millefolium		common yarrow	
ACHMILALP	Yes	Achillea millefolium var. alpicola		common yarrow	
ACHMILCAL	Yes	Achillea millefolium var. californica		common yarrow	
ACHMILLAN	Yes	Achillea millefolium var. lanulosa		common yarrow	
ACHMILMIL	Yes	Achillea millefolium var. millefolium			
ACHMILOCC	Yes	Achillea millefolium var. occidentalis			
ACHNELDOR	Yes	Achnatherum nelsonii ssp. dorei			
ACHTHU	Yes	Achnatherum thurberianum			
ACHTRI	Yes	Achlys triphylla		Deerfoot vanilla leaf	
ACOCOL	Yes	Aconitum columbianum			
ACTRUB	Yes	Actaea rubra			
ACTRUBARG	Yes	Actaea rubra ssp. arguta		Western baneberry	
ADEBIC	Yes	Adenocaulon bicolor		Trail plant	

The Species Information Form can be used for adding or editing species records. Required fields are shown in bold, and items with an asterisk (*) next to the name are not to be edited except by the Data Manager (these come from either ITIS or the NPSpecies application). The Integrated Taxonomic Information System (ITIS) website may be accessed by clicking on the button labeled 'ITIS website', or by clicking on either the Taxonomic Serial Number (TSN) or scientific name if either of these fields is already populated. All new records – except for unknown taxa or temporary names – should have TSN entered if it exists on the ITIS website.



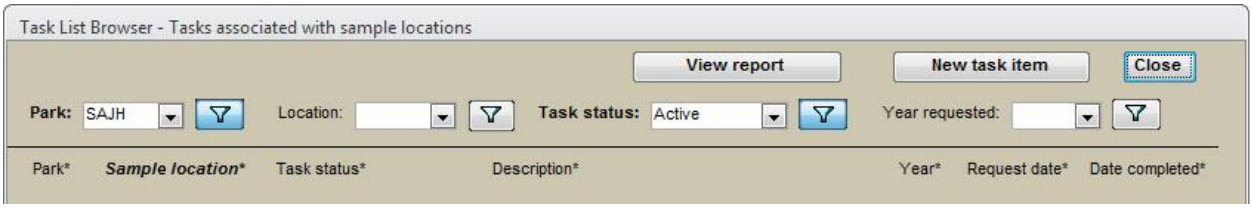
The second tab of the lookups module is a list of contacts for the project. By selecting a contact record and clicking on the "View / edit" button, or by double-clicking on a contact record, the Contact Information Form is opened in edit mode. Once edits are accepted with the "Done" button, the user may either page through the records using the record navigator at the bottom of the form, or may search for a particular name in the drop-down pick list.



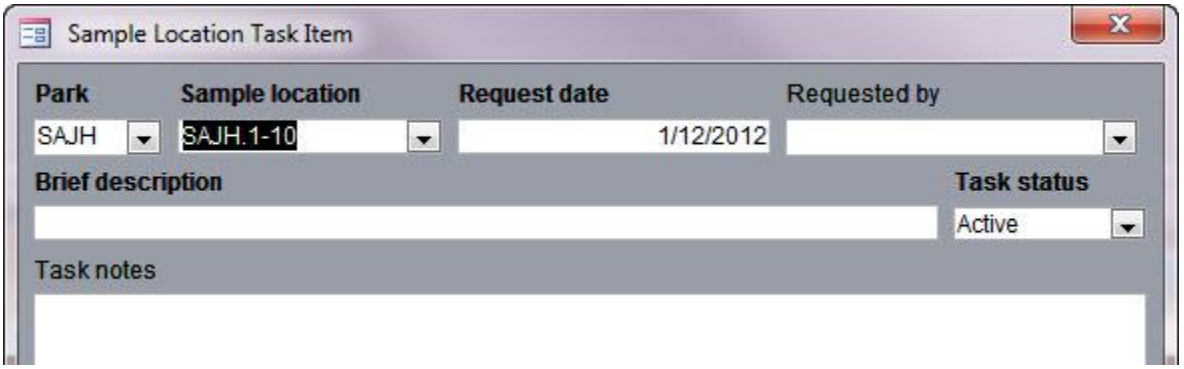
The third tab in the Manage Lookups Form has a dropdown pick list for selecting other lookup tables in the database. This can be useful when a user needs to learn more about the domain values and definitions for the project. These lookups may be edited only by power users and administrators.

Site Task List

The Task List Browser Form functions in much the same way as the Data Gateway Form, and can be sorted or filtered by park, location type, task status or request year. Click on the "Closeup" button to view or edit information for that record.

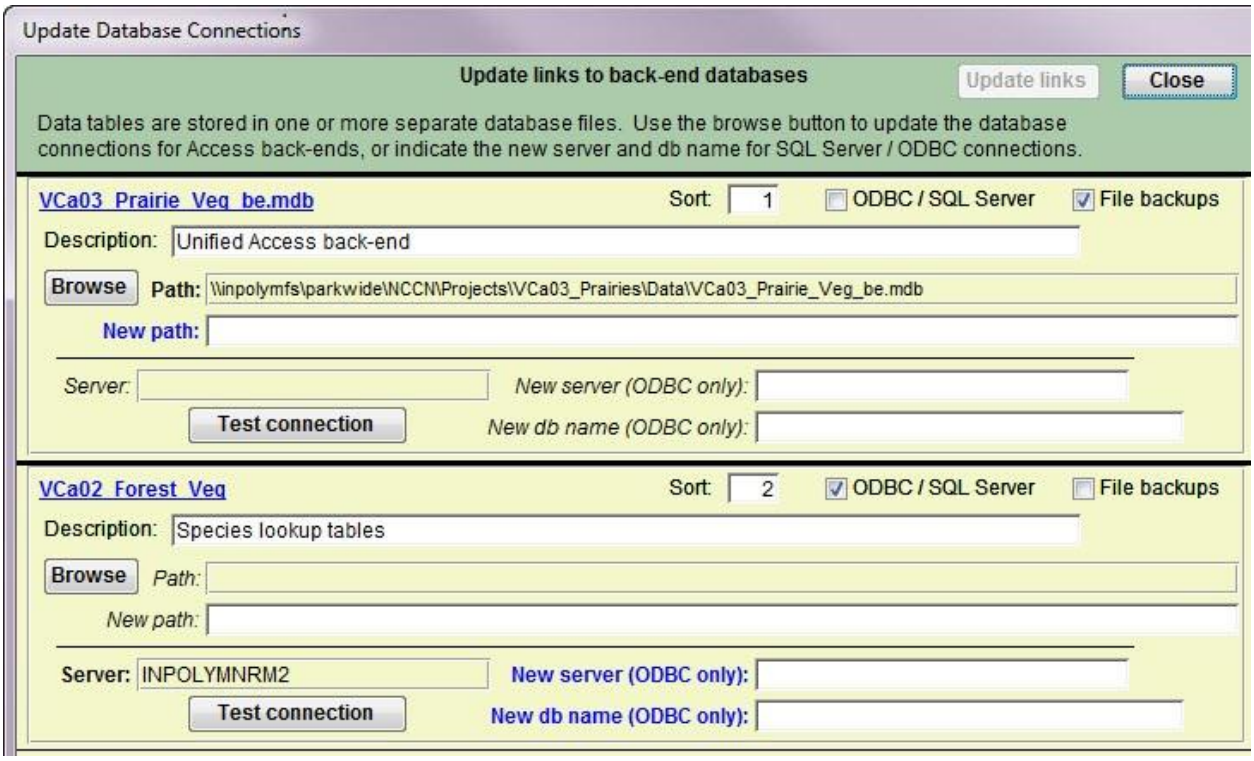


Close-up view for entering/editing location task items:



Update Database Connections

When first using the front-end application, the user may need to establish the connections to the back-end database(s). Database connections can be updated using the Update Database Connections form, available by clicking on the 'Db connections' button on the main switchboard menu. A separate record will be shown for each back-end database. For SQL Server databases, specify the server and database name. For Access back-ends, browse to the desired back-end file. To complete the connection updates, click on 'Update links'.


Update Database Connections
Update links to back-end databases
Update links
Close
Data tables are stored in one or more separate database files. Use the browse button to update the database connections for Access back-ends, or indicate the new server and db name for SQL Server / ODBC connections.
VCa03_Prairie_Veg_be.mdb
Sort: 1
ODBC / SQL Server
File backups
Description: Unified Access back-end
Browse
Path: \\inpolymfs\parkwide\NCCN\Projects\VCa03_Prairies\Data\VCa03_Prairie_Veg_be.mdb
New path:
Server:
New server (ODBC only):
Test connection
New db name (ODBC only):
VCa02_Forest_Veg
Sort: 2
ODBC / SQL Server
File backups
Description: Species lookup tables
Browse
Path:
New path:
Server: INPOLYMNRM2
New server (ODBC only):
Test connection
New db name (ODBC only):

SOP 11: End of Field Season Debriefing and Close-out

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP outlines the procedure for meeting to debrief the crew and close out the field season. This is to occur during the last week of work for the seasonal field technicians and volunteers/interns.

Preparation

By the end of the field season all data should be entered into the database and verified by the crew. In addition, all images, scanned field forms, and GPS files should be accounted for, named and filed appropriately in the project workspace. The crew should be prepared for debriefing on the scheduled day during the last week of work. Equipment should be inventoried and any borrowed equipment returned. The Crew Lead should prepare a "Field Season Report," noting any unfinished work, so that the park plant ecologist can arrange for its completion.

Debriefing

The objective of the debriefing is to understand and summarize how the field season went, what worked and what can be improved for next year. The Project Lead and the SAJH Resource Chief should let the crew know ahead of time that there will be a meeting to discuss the accomplishments and challenges of the field season. The crew should review this SOP before beginning their last week of work, write down their thoughts and responses to the items below for discussion at the debriefing, and add additional items that come to mind. Meeting notes should be recorded for future reference. The subjects to be covered include the following:

<u>Organization Issues</u>
How did you feel about each of the following parts of the field season? What went well and where could improvements be made?

- Orientation (helpful, organized, logical, and applicable?)(review orientation agenda)
- Planning
- Scheduling
- Tours
- Communication (Project Lead and SAJH Resource Chief, Project Lead to Field Crew Lead, SAJH Resource Chief to Field Crew Lead, Field Crew Lead to field crew, between crew members)

Field issues

How did you feel about each of the following:

- Field tours - Were you mentally and physically prepared for your season?
- Training – Was the training adequate for GPS use; map, compass, and laser range finder; and safety? (training for data collection addressed in next section)
- Transportation – were vehicles adequate, functional and safe?
- Field safety - Did you encounter any safety issues; what did you do to address them?
- Suggestions for avoiding injuries next year (Updates to the Job Hazard Analysis)

Data Collection

How did you feel about each of the following parts of data collection? What went well and where could improvements be made?

- Training – Was the training adequate for data collection?
- Traversing transects with GPS
- Mapping cover type changes with GPS, creating offsets with GPS and laser range finder
- Locating herbaceous vegetation quadrats with GPS
- Plot set-up
- Sampling
  - Taking digital images
  - Voucher collection
  - Plant Identification
- Data forms

Technical Issues

- Field equipment - Did you have the right equipment to get the job done safely and efficiently? (e.g. GPS, Laser range finders, cameras, clipboards, paper, etc.)
- GPS / GIS support
- Did the GPS procedures work and how can they be improved?
- Radio use

Office

- Office time
- Computers and network access
- Office supplies
- Database and data entry (with database support person)
- Field form scanning
- Image management procedures
- Status of the data

Plans for next year

Go over the plans for next year. Let the crew know about rehire status for their current position, approximately when the job announcement will be on USAJOBS should they wish to apply, and what incentives may be available to them should they return.

Contact information

Consider collecting contact information from the crew. If any questions arise about the data we may need to contact the crew person that collected the data. Ideally data quality review and certification will have been conducted by the end of the field season, but with our short season, this may not be possible.

Equipment Assessment and Return

The Crew Lead is responsible for ensuring the inventory, return, and documentation of field equipment. By the last day the crew will return all equipment that was borrowed for the field season. This should include field notebooks. Use the original check-out list to check-in the equipment. Note any equipment that was lost or damaged. Record what needs to be fixed or replaced and indicate if an improved model is desired. GPS units will need to be returned on the day determined by the GIS Specialist at the time of unit check-out as they are used by multiple programs during the field season. The GPS units should be returned to the GIS Specialist so they can be recharged and programmed for the next user. Organize and store the equipment so that it is contained and easily accessible for the next season. Create a list of needed items in the folder \Documents\Equipment in the project workspace, indicating the year in the file name, so that it is easily accessible when it is time to order equipment and supplies for the next field season.

Check Out

On the last day of work the field crew members will go through the NPS check-out procedure, unless they will be working on another project. Check-out entails getting the check-out form signed off by various authorities as equipment and keys are turned in.

Field Season Reporting

Each Crew Lead should prepare a brief report (generally not more than three pages) that includes the following:

- Clear enumeration of which transects were mapped and which quadrats were sampled, and which were only partially mapped and sampled during the season.
- Description of any logistic difficulties that arose, and explanation of how they were addressed.
- Clear documentation and explanation of any deviations from established procedures.
- Discussion of any interesting or potentially important observations about the parks' vegetation or wildlife that may have been noted during the field season.
- Suggestions for improving the training or field season logistics.
- An inventory of field equipment, quantity and condition.

SOP 12: Data Quality Review and Certification

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP describes the procedures for validation and certification of data in the project database. Refer also to protocol narrative **Section 4C, Overview of Database Design**, **Section 4E Quality Review**, and **Section 4G, Data Certification and Delivery** for related guidance.

A critical part of project quality assurance is the year-end data quality review and certification. After the season's field data have been entered and processed, they need to be reviewed and certified by the Project Lead before they can be used for analysis and reporting. Data validation is the process of rigorously testing data for completeness, structural integrity, and logical consistency. Although the front-end data entry forms have built-in quality assurance measures – such as domain lookup pick lists, defined range limits for numeric data, and checks for missing values – not all errors can be caught during the data entry step. The following are a few of the general sources of data problems that might be identified during the validation:

1. The response design is ambiguous or insufficiently documented to prevent data gaps and logical inconsistencies.
2. There were logistics problems or a change of plans that prevented a complete sample (e.g., weather conditions, staffing changes).
3. Field crew members did not collect or properly record one or more data elements in the field.
4. Data were entered incorrectly or incompletely.
5. Database records were edited incorrectly or deleted after entry.
6. There is a design flaw in the front-end application that causes data errors during or after data entry.

Given the varied sources of data problems, there is a need for a thorough check of data quality on a regular basis as a means of ensuring continued data quality throughout the span of the project. The front-end database application includes a Quality Review Tool to facilitate the review process by showing the results of pre-built queries that check for data integrity, data outliers, missing values, and illogical values. The user may then fix these problems and document the fixes. Not all errors and inconsistencies can be fixed (e.g., missing response variable values), in which case documentation of the resulting errors and why records were not fixed is included in the metadata and certification report.

Once the data have been through the validation process and metadata have been developed for them, the Project Lead should certify the data by completing the NCCN Project Data Certification Form, available on the NCCN website.

Data Quality Review

Validation Queries

The database application contains a set of pre-built database queries that check for potential problems in the data set, including data outliers, missing values, and illogical values. The set of queries is customized to match project requirements and the structure of the underlying data model. Each query is classified in one of three categories:

1. Critical – These queries check for structural integrity problems or gaps in critical information. This category might include queries that check for missing primary key values, mismatches between data values and lookup domain values, duplicate records, or illogical data combinations. Records returned by these queries fail to meet basic project requirements or structural requirements of the data model, and must be fixed so that they do not return any records before the data can be certified.

2. Warning – These queries represent problems that range in importance, but in any case have the potential to compromise data usability or representativeness if they are not addressed or at least made known to the end user. This category might include queries that check for missing response variables (e.g., substrate or cover class) or values that are beyond a reasonable range; alternatively, it may include queries that require follow-up on data records that can only be done after the field season (e.g., changing status of a monitoring location from "Proposed" to "Active"). The person performing the quality review should make efforts to fix as many of these records as possible by reviewing hard-copy data forms or otherwise following up. However, it may frequently be the case that records in this category cannot be fixed because the reviewer does not have the information needed to fix the record. In such cases the reviewer should provide documentation about which records were not fixed and why using the space provided in the quality review tool (see below). If there are numerous records that cannot be fixed, a general description such as "80 records" or "all reconnaissance sites, 43 records", along with a statement of why these were not fixed, will suffice. Documentation will help future data users to know that reasonable efforts were made to address the problems.

3. Information – These queries provide information that can be used to evaluate the completeness and logical consistency of the data set – for example, the number of plots visited per park in a given season, the range of dates for sampling visits, or the number of species recorded during a sampling event. This category may also include checks for missing values in less-vital or optional fields, where a large number of missing values may be anticipated on a regular basis (i.e., as an alternative to making these Warning queries that require follow-through and documentation).

The queries are named and numbered hierarchically so that high-order information – for example, from tables on the parent side of a parent-child relationship such as sample locations –

is addressed before low-order information (e.g., individual species observation records). The rationale for this is that one change in a high-order table affects many downstream records, and so proceeding in this fashion is the most efficient way to isolate and treat errors.

The set of queries may need to be augmented or changed as project requirements shift. The Data Manager is also available to revise queries or construct new database queries as needed. Throughout the quality review, the person performing the review should remain vigilant for problems that may not be caught by the validation queries. One task that cannot be automated is the process of making sure that all of the data for the current season are in fact entered into the database. This will often involve manual comparisons between field forms or other lists of the sites visited against the results of queries showing the sites for which data exist.

Using the Quality Review Tool

Open the front-end database application and hit the button labeled "QA checks" to open the quality review form. Upon opening, the quality review form automatically runs the validation queries and stores the results in a back-end database table (tbl_QA_Results). Each time the query results are refreshed, the number of records returned and the run times are updated so that the most recent result set is always available. Reviewer name and remedy descriptions are retained between query runs. Together, these results form the basis of documentation in the certification report output as shown below.

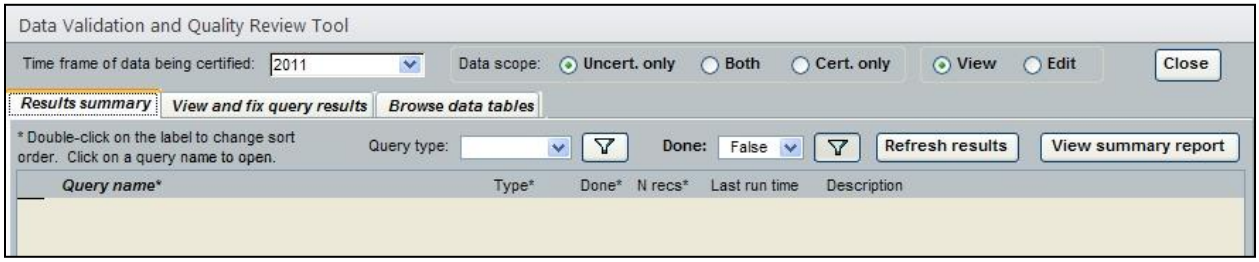
Across the very top of the form are indicators of the time frame (i.e., sample year) and scope of the data being validated. Data scope has three options:

- Uncertified data only (default) – Only uncertified events (i.e., those from the current sampling year) will be considered in validation queries. Note that by design, certain queries will evaluate for problems in records are associated with certified data anyway – for example, all location records are evaluated for duplicate location codes, even those associated only with certified sampling events.
- Both uncertified and certified data – All database records will be included, including certified event data from previous years.
- Certified data only – Only certified events from previous seasons will be considered in the validation queries.

Changing the data scope will show only results for that scope – in other words, results and fixes associated with one scope will be retained even if the scope is changed and the results are refreshed.

The first tab of the quality review form contains a results summary showing each validation query, the type of query (i.e., Critical, Warning or Information), the number of records returned by the query, the most recent query run time, and the description. At the top of the page, there is a button for refreshing the full set of results, which may need to be done periodically as changes in one part of the data structure may change the number of records returned by other queries. Records default to sort by query name, but can be sorted by double-clicking on any of the column headings indicated with an asterisk.

There is also a "Done" checkbox that the reviewer can use as an indicator that they are finished looking at that particular query. Critical and Warning queries that return zero records from the start are automatically set to "Done". The results records may be filtered by query type and/or by whether or not the query has been marked as "Done". Note that updating records in one query may change the number of records returned by another query; if the number of records returned by a query changes, the "Done" indicator will be switched off automatically.



Upon double-clicking a particular query name, the second page will open up to show the results from that query. The "Query description" field will indicate the kind of records returned, and may also include a suggested remedy.

In the upper-right is a switch that allows the user to put the form in either view mode (default) or edit mode. Upon changing to edit mode, the form changes color to provide a visual reminder that edits are possible. At this point the query results may be modified and any documentation may be entered in the "Remedy details" section. If certain records in a query result set are not to be fixed for whatever reason, this is also the place to document that. Reviewer name is automatically filled in (if it was blank) once the user updates the documentation. If the reviewer does not have sufficient information to fix one or more records returned by a query, s/he should describe which records were not fixed and why. If there are numerous records that cannot be fixed, a general description such as "80 records" or "All reconnaissance sites, 43 records", along with a statement of why these were not fixed, will suffice. Documentation will help future data users to know that reasonable efforts were made to address the problems.

Some of the other functions of this second page of the Quality Review Tool:

- Edit results directly? – A flag to indicate whether the results for the selected query can be edited directly inside the query results subform. Queries that contain complex joins, subqueries, or grouping functions cannot be edited directly, and instead must be edited in the original data entry form.
- Auto-fix – A button that runs an action query for bulk updates if such a solution is appropriate and available (e.g., replacing all missing values with a code for "Unknown"). Not all validation queries contain references to a bulk update query.
- Open selected record – Opens the selected record returned by the query in the appropriate form. This is useful for quickly moving to the place where the fix can be made most efficiently, and taking advantage of existing quality assurance functionality.
- Data browser – Opens the Data Browser form, which provides comprehensive access to data arranged by sampling location.
- Export to Excel – Exports the validation query results to Excel. This can be helpful when there is a need to follow up on complex problems or to verify that all data have been entered.
- Requery – Reruns the validation query and updates the results set.

On this page is also a button labeled "Design view", which will open the currently selected query in the design interface in Access. In this manner, the user can verify that the query is in fact filtering records appropriately. Note: Please contact the Data Manager before making any changes to query structure or names.

Finally, the third page of the Quality Review Tool is for viewing and editing data tables directly if needed. This page is only available for those with power user or administrator privileges to the database. Important: As with all edits performed during the quality review, these types of direct edits in the data tables should be made with extreme care as many of the quality assurance measures built into the data entry forms are not present in the tables themselves. It is possible, therefore, to make edits to the tables that may result in a loss of data integrity and quality.

Completing Data Certification

Data certification is a benchmark in the project information management process that indicates that: 1) the data are complete for the period of record; 2) they have undergone and passed the quality assurance checks outlined above; and 3) they are appropriately documented and in a condition for archiving, posting and distribution as appropriate. Certification is not intended to imply that the data are completely free of errors or inconsistencies that may or may not have been detected during quality assurance reviews.

To ensure that only quality data are included in reports and other project deliverables, the data certification step is an annual requirement for all tabular and spatial data. The Project Lead is the primary person responsible for completing an NCCN Project Data Certification Form, available at: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm. This brief form should be submitted with the certified data according to the timeline in **Appendix C: Yearly Project Task List**. Refer to **SOP 13: Product Delivery, Posting and Distribution** for delivery instructions.

Generating Output for the Certification Report

The first page of the Quality Review Tool has a button labeled “View summary report”. This button opens the formatted information for each query, the last run time, the number of records returned at last run time, a description and any remedy details that were typed in by the user. This report can be exported from the database and included as an attachment to the certification report.

SOP 13: Product Delivery, Posting and Distribution

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP provides a schedule, product specifications, and instructions for delivering completed data sets, reports and other project deliverables for long-term storage (Table 13.1). Details are also provided on posting products to websites and clearinghouses, and on responding to data requests.

Product Delivery Schedule and Specifications

Table 13.1. Schedule and instructions for project deliverables.

Deliverable Product	Primary Responsibility	Target Date	Delivery Instructions
Field season report	Crew Lead	July 15 of the same year	Upload digital file in Microsoft Word format to the NCCN Digital Library.
Raw GPS data files	Crew Lead	July 15 of the same year	Store in appropriate sections of the project workspace.
Processed GPS data files	GIS Specialist	October 15 of the same year	
Digital photographs	Project Lead	November 30 of the same year	Organize, name and maintain photographic images in the project workspace according to **SOP 9: Managing Photographic Images**.
Certified back-end database	Project Lead	November 30 of the same year; data are not published until two years after the certification date	Refer to the section in this SOP on delivering certified data and related materials.
Certified geospatial data	Project Lead with GIS Specialist		
Data certification report	Project Lead		
Metadata interview form	Project Lead		
Full metadata (parsed XML)	Data Manager and GIS Specialist	March 15 of the following year	Upload the parsed XML record to the NPS Data Store [1].
Annual I&M report	Project Lead	Apr 30 of the following year	Refer to the section in this SOP on reports and publications.
5-year analysis report	Project Lead and Data Analyst	Every 5 years by September 1 of the following year	
Other publications	Project Lead and Data Analyst	As completed	

Table 13.1. Schedule and instructions for project deliverables (continued).

Deliverable Product	Primary Responsibility	Target Date	Delivery Instructions
Field data forms	Project Lead	April 30 of the following year	Scan original, marked-up field forms as PDF files and store in the project workspace. Hard copy originals go to the Park Curator for archiving 6 years after data collection.
Other records	Project Lead	Review for retention every January	Retain or dispose of records following NPS Director's Order 19 [2]. Organize and send analog files to Park Curator for archiving. Digital files that are slated for permanent retention should be uploaded to the NCCN Digital Library.

[1] The NPS Data Store is an internet clearinghouse of documents, data and metadata on natural and cultural resources in parks. It is a primary component of the NPS Integrated Resource Management Applications (IRMA) portal (http://irma.nps.gov).

[2] NPS Director's Order 19 provides a schedule indicating the amount of time that the various kinds of records should be retained. Available at: http://home.nps.gov/applications/npspolicy/DOrders.cfm

NCCN Digital Library

The NCCN Digital Library is a document management system maintained in a Microsoft SharePoint environment at: http://imnetsharepoint/nccn/default.aspx. The primary purpose of this system is to maintain important digital files – such as reports, protocol documents, and select project images – within a content management system, and to make them available to NCCN and NPS users. NCCN users may view, post and edit documents within this system; other NPS users have read-only access to these files, except where information sensitivity may preclude general access.

To enable discovery and long-term usability of key documents, certain information about each file needs to be filled in as files are uploaded, for example:

- Document title
- Project code (e.g., "VCa03" for Prairie Vegetation Monitoring)
- Park(s) to which the file(s) apply; multiple parks may be selected for each upload
- Document type (e.g., formal report, database, protocol, etc.)
- Date of publication or last revision
- Author name(s)
- Sensitivity: Sensitive, NPS Only, or Public. Sensitive files will not be viewable without permission. For a definition of sensitive information, see **Section 4J, Identifying and Handling Sensitive Information**.
- Description - Document abstract, additional authors and credits, special use instructions, etc.

For project staff without access to the NPS intranet, files may be sent by email or CD/DVD to the Project Lead or Data Manager for upload, along with the above information in a text file or accompanying email.

Park Collections

The collections at NOCA will serve as the park of record for the Prairie Vegetation Monitoring Project. Voucher specimens, hardcopy field forms, and printouts of annual reports, technical reports, and other publications will be filed there. In addition, other hard copy project records should be reviewed and organized on an annual basis (or at the conclusion of a project), and sent to park collections for long-term storage.

The Project Lead should contact the Park Curator during the project planning if voucher specimens will be collected. All specimens must be labeled with NPS accession and catalog numbers, and with advance notice the Park Curator can help to provide these numbers ahead of time so they can be included in label printouts. Specimen label information will be entered by the Park Curator into the ANCS+ database. The Park Curator will help to decide which and how many specimens can be maintained at the park versus sent to another institution or collection. Collected materials remain NPS property even if they later reside in a non-NPS collection (e.g., university herbarium).

Delivering Certified Data and Related Materials

Data certification is a benchmark in the project information management process that indicates that the data: 1) are complete for the period of record; 2) have undergone and passed the quality assurance checks; and 3) are appropriately documented and in a condition for archiving, posting and distribution as appropriate. To ensure that only quality data are included in reports and other project deliverables, the data certification step is an annual requirement for all tabular and spatial data. For more information refer to **SOP 12: Data Quality Review and Certification**.

The following deliverables should be delivered as a package:

- Certified back-end database – Database containing data for the current season that has been through the quality assurance checks documented in **SOP 12: Data Quality Review and Certification**. Delivery of this item is only applicable in cases where the back-end database is implemented in Microsoft Access and/or is deployed outside the NPS firewall during the quality review. In all other cases, the Data Manager will already have access to the certified data.
- Certified geospatial data – GIS themes in ESRI shapefile or geodatabase format. Refer to NCCN GIS Development Guidelines (NCCN 2009) and NCCN GIS Product Specifications (NCCN 2007a) for more information.
- Data certification report – A brief questionnaire in Microsoft Word that describes the certified data product(s) being delivered. A template form is available on the NCCN website at: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm.
- Metadata interview form – The metadata interview form is a Microsoft Word questionnaire that greatly facilitates metadata creation. It is available on the NCCN

website at: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm. For more information, refer to **Section 4F, Metadata Procedures**.

After the quality review is completed, the Project Lead should package the certification materials for delivery as follows:

1. Create a compression file (using WinZip® or similar software, or by right-clicking in Windows Explorer). This file should be named in accordance with general file naming standards, and the name should include the project code (VCa03) and the year or span of years for the data being certified. For example: VCa03_2012_certification_pkg.zip.
2. In cases where the back-end database is implemented in Microsoft Access and/or is deployed outside the NPS firewall during the quality review:
   a. Open the certified back-end database file and compact it (in Microsoft Access version 2003 and earlier, Tools > Database Utilities > Compact and Repair Database). This will make the file size much smaller. Back-end files are typically indicated with the letters "_be" in the name (e.g., VCa03_Prairie_Veg_be.mdb).
   b. Add the back-end database file to the compression file.
   c. Note: The front-end application does not contain project data and as such should not be included in the delivery file.
3. Add the completed metadata interview and data certification forms to the compressed file. Both files should be named in a manner consistent with the file naming standards described in **SOP 1: Project Workspace and Records Management**.
4. Add any geospatial data files that are not already in the possession of the GIS Specialist. Geospatial data files should be developed and named according to NCCN GIS Naming Conventions (NCCN 2007b).
5. Deliver the compressed file containing all certification materials to the Data Manager by placing it in the Data folder of the project workspace and notifying the Data Manager by email. If the Project Lead does not have network access, then certification materials should be delivered as follows:
   a. If the compressed file is under 9.5 mb in size, it may be delivered directly to the Data Manager by email.
   b. If the compressed file is larger than 9.5 mb, it should be copied to a CD or DVD and delivered in this manner. Under no circumstances should products containing sensitive information be posted to an FTP site or other unsecured web portal (refer to **Section 4J, Identifying and Handling Sensitive Information**).

Upon receiving the certification materials, the Data Manager will:

1. Review them for completeness and work with the Project Lead if there are any questions.
2. Check in the delivered products using the NCCN project tracking application.
3. Notify the GIS Specialist if any geospatial data are delivered. The GIS Specialist will then review the data, and update any project GIS data sets and metadata accordingly, and file those products in the project workspace.
4. Work with the GIS Specialist to finalize coordinate data in the database, generate public coordinates (as applicable – see **Section 4J, Identifying and Handling Sensitive Information**), and update any GIS-derived data fields therein (e.g., elevation, slope, aspect).

5. Archive the certified products in the project workspace.
6. Notify the Project Lead that the year's data have been successfully reviewed and processed. The Project Lead may then proceed with data summarization, analysis and reporting.
7. Develop, parse and post the XML metadata record to the NPS Data Store.
8. After a holding period of two years, the Data Manager will upload the certified data to the NPS Data Store. This holding period is to protect professional authorship priority and to provide sufficient time to catch any undetected data quality problems.

No sensitive information (e.g., information about the specific nature or location of protected resources) may be posted to the NPS Data Store or any other publicly-accessible website, or otherwise shared or distributed outside NPS without a confidentiality agreement between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared. Only products that are intended for public/general-use may be posted to public websites and clearinghouses – these may not contain sensitive information.

Instructions for Reports and Publications

Annual reports and trend analysis reports will use the NPS Natural Resource Publications template, a pre-formatted Microsoft Word template document based on current NPS formatting standards. Annual reports will use the Natural Resource Technical Report (NRTR) template, and trend analysis and other peer-reviewed technical reports will use the Natural Resource Report (NRR) template. These templates and documentation of the NPS publication standards are available at: http://www.nature.nps.gov/publications/NRPM/index.cfm.

The procedures for annual reports, technical reports, and publications are as follows. (Note: This is optional for field season reports, which are intended to be internal communications only.)

1. The Project Lead or Data Analyst formats the document according to the NPS Natural Resource Publications standards.
   a. Formatting according to NPS standards is easiest when using the report template from the very beginning, as opposed to reformatting an existing document.
   b. When creating the file, use appropriate naming standards (described in this document). If creating the document in SharePoint (e.g., the NCCN Digital Library), attribute the file as a draft; otherwise add "DRAFT" to the file name.
   c. Open the document and add "DRAFT" to the header or document watermark as appropriate.
2. The document should be peer reviewed at the appropriate level. For example, I&M Annual Reports should be reviewed by other members of the project work group. The Network Program Manager will also review all annual reports for completeness and compliance with I&M standards and expectations. Before sending the document for review, rename the document by adding a date stamp to the end of the file name using the YYYYMMDD format.
3. Upon completing the peer review, the Project Lead should acquire a publication series number from the appropriate regional or national key official. Instructions for acquiring a series number are available at: http://www.nature.nps.gov/publications/NRPM/index.cfm.
4. The Project Lead should finalize the document:

a. Ensure that the publication/version date (last saved date field code in the document header, if used) and file name (field code in the document footer, if used) are updated properly throughout the document.
b. Remove the word "DRAFT" from watermarks, document headers, and file name.
c. Remove any previous date stamp from the file name.
d. If the document has been developed and maintained in SharePoint (e.g., the NCCN Digital Library), update the document attribute to "Final".
e. To avoid unplanned edits to the document, reset the document to read-only by right-clicking on the document in Windows Explorer and checking the appropriate box in the Properties popup.
f. Create a PDF version of the document and upload the final file and PDF copy to the NCCN Digital Library for long-term storage.
g. Store both the Word document and PDF copy in the appropriate section of the project workspace (see **SOP 1: Project Workspace and Records Management**).

5. Notify the Park Curator and Data Manager that the report is available, and send a printout to the Park Curator to add to the host park collections.
6. The Data Manager (or a designee) will create a bibliographic record and upload the PDF copy to the NPS Data Store according to document sensitivity.

File Naming Standards

Prior to delivering or uploading digital products, files should be named according to the naming conventions appropriate to each product type.

Reports and Publications

- No spaces or special characters in the file name.
- Use the underbar ("_") character to separate file name components.
- Try to limit file names to 30 characters or fewer, up to a maximum of 50 characters.
- Dates should be formatted as YYYYMMDD.
- As appropriate, include the project code (e.g., "VCa03"), network code ("NCCN"), and year in the file name.

Examples:

- NCCN_VCa03_2011_Annual_report.pdf
- NCCN_VCa03_2011_Field_season_report.doc
- NCCN_VCa03_2011_Certification_report.doc

Other Files

General naming standards as described in **SOP 1: Project Workspace and Records Management** apply to all deliverables. When delivering files to the NCCN Digital Library, file names should be modified as needed to include the project code (e.g., "VCa03"), network code ("NCCN") or park code, and year as appropriate (e.g., NCCN_VCa03_2012_cert_package.zip). Specific standards for images are described in **SOP 9: Managing Photographic Images** and in **SOP 15: Revising the Protocol** for protocol documents.

Product Posting

Once digital products have been delivered and processed, the Data Manager or a designee will post them to or otherwise update the following applications to make them generally available:

1. The NPS Data Store is an internet clearinghouse for documents, data and metadata on natural and cultural resources in parks. It is a primary component of the NPS Integrated Resource Management Applications (IRMA) portal (http://irma.nps.gov). Refer to the section on sensitive information in **Section 4J, Identifying and Handling Sensitive Information** for information on options for flagging products containing sensitive information within the system, or for modifying products prior to posting so that they no longer contain sensitive information and can therefore be shared broadly. Full metadata records will be posted to the NPS Data Store as they are created; data sets will be posted after a two-year hold to protect professional authorship priority and to provide sufficient time to catch any undetected quality assurance problems. For reports and other publications, an online record is created after first verifying that one does not already exist. The digital report file in PDF format is then uploaded.

2. NPSpecies is the NPS database and application for maintaining park-specific species lists and observation data, and is also a component of the IRMA portal (http://irma.nps.gov). Species observations will be extracted from project data sets and uploaded into NPSpecies.

3. NCCN Web Site is maintained by NCCN staff as part of the NPS Inventory and Monitoring web site (http://science.nature.nps.gov/im/units/nccn) to describe our program, the vital signs selected for monitoring, and to highlight certain products and information derived from inventory and monitoring work at NCCN. The site has both internet and intranet components. Select products such as annual reports and technical reports will be posted to the web site.

These applications serve as the primary mechanisms for sharing reports, data, and other project deliverables with other agencies, organizations, and the general public.

Holding Period for Project Data

To protect professional authorship priority and to provide sufficient time to complete quality assurance measures, there is a two-year holding period before posting or otherwise distributing certified project data. This means that certified data sets are first posted to publicly-accessible websites (i.e., the NPS Data Store) approximately 24 months after they are certified (e.g., data collected in June 2012 and certified in January 2013 becomes generally available through the NPS Data Store in January 2015). In certain circumstances, and at the discretion of the Project Lead, data may be shared before a full two years have elapsed.

Note: This hold only applies to raw data, and not to metadata, reports or other products which are posted to NPS clearinghouses immediately after being received and processed.

Responding to Data Requests

Occasionally, a park or project staff member may be contacted directly regarding a specific data request from another agency, organization, scientist, or from a member of the general public. The following points should be considered when responding to data requests:

- For all Inventory and Monitoring projects in NCCN, NPS is the originator and steward of the data, and the NPS Inventory and Monitoring Program should be acknowledged in any professional publication using the data.
- NPS retains distribution rights; copies of the data should not be redistributed by anyone but NPS.
- The data that project staff members and cooperators collect using public funds are public records and as such cannot be considered personal or professional intellectual property.
- No sensitive information (e.g., information about the specific nature or location of protected resources) may be posted to the NPS Data Store or any other publicly-accessible website, or otherwise shared or distributed outside NPS without a confidentiality agreement between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared. Refer to **Section 4J, Identifying and Handling Sensitive Information**.
- For quality assurance, only certified, finalized versions of data sets should be shared with others. In exceptional cases where a provisional data set needs to be shared with others prior to certification:
    - Any accompanying communications should clearly indicate that the data set is provisional and subject to change according to our quality review process.
    - File names and the media it is sent on should be clearly labeled as containing provisional data not for distribution.

The Project Lead will handle all data requests as follows:

1. Discuss the data request with other network and park staff members (e.g., Network Plant Ecologists and the SAJH Chief of Resources) as necessary to decide on an appropriate response to the request.
2. Notify the Data Manager if s/he is needed to facilitate fulfilling the request in some manner.
3. Respond to the request in an official email or memo.
4. In the response, refer the requestor to the NPS Data Store and the IRMA portal (http://irma.nps.gov), so they may download the necessary data and/or metadata. If the request cannot be fulfilled in that manner – either because the data products have not been posted yet, or because the requested data include sensitive information – work with the Data Manager to discuss options for fulfilling the request directly (e.g., writing data to CD or DVD). Ordinarily, only certified data sets should be shared outside NPS.
5. It is recommended that documents and presentation files be converted to PDF format prior to distribution. This is to maximize portability and to reduce the ability for others to alter and redistribute files.
6. If the request is for data that may reveal the location of protected resources, refer to the next section in this document about sensitive information and also to **Section 4J, Identifying and Handling Sensitive Information**.
7. After responding, provide the following information to the Data Manager, who will maintain a log of all requests in the NCCN project tracking database:

a. Name and affiliation of requestor
b. Request date
c. Nature of request
d. Responder
e. Response date
f. Nature of response
g. List of specific data sets and products sent (if any)

Freedom of Information (FOIA) Requests

All official FOIA requests will be handled according to NPS policy. The Project Lead will work with the Data Manager and the park FOIA representative(s) of the park(s) for which the request applies.

Special Procedures for Sensitive Information

Products that have been identified upon delivery by the Project Lead as containing sensitive information will normally be revised into a form that does not disclose the locations of protected resources – most often by removing specific coordinates and only providing coordinates that include a random offset to indicate the general locality of the occurrence. If this kind of measure is not a sufficient safeguard given the nature of the product or the protected resource in question, the product(s) will be withheld from posting and distribution.

If requests for distribution of products containing sensitive information are initiated by the NPS, by another federal agency, or by another partner organization (e.g., a research scientist at a university), the unedited product (i.e., the full data set that includes sensitive information) may be shared only after a confidentiality agreement has been established between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared. Refer to **Section 4J, Identifying and Handling Sensitive Information** for more information.

References Cited

North Coast and Cascades Network (NCCN). 2009. GIS development guidelines. USDI National Park Service. Available at: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm

North Coast and Cascades Network (NCCN). 2007a. GIS product specifications. USDI National Park Service. Available at: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm

North Coast and Cascades Network (NCCN). 2007b. GIS naming conventions. USDI National Park Service. Available at: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm

SOP 14: Sensitive Information Procedures

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

Although it is the general NPS policy to share information widely, the NPS also realizes that providing information about the location of park resources may sometimes place those resources at risk of harm, theft, or destruction. This can occur, for example, with regard to caves, archeological sites, tribal information, and rare plant and animal species. Therefore, information will be withheld when the NPS foresees that disclosure would be harmful to an interest protected by an exemption under the Freedom of Information Act (FOIA). The National Parks Omnibus Management Act, Section 207, 16 U.S.C. 5937, is interpreted to prohibit the release of information regarding the "nature or specific location" of certain cultural and natural resources in the national park system. Additional details and information about the legal basis for this policy are in the NPS Management Policies (National Park Service 2006) and in Director's Order 66 (available at: http://home.nps.gov/applications/npspolicy/DOrders.cfm).

These guidelines apply to all NCCN staff, cooperators, contractors, and other partners who are likely to acquire or otherwise have access to information about protected NPS resources. The Project Lead has primary responsibility for ensuring adequate protection of sensitive information related to this project.

The following are highlights of our strategy for protecting this information:

- Protected resources, in the context of the NCCN Inventory and Monitoring Program, include species that have State- or Federally-listed status, and other species deemed rare or sensitive by local park taxa experts.
- Sensitive information is defined as information about protected resources that may reveal the "nature or specific location" of protected resources. Such information must not be shared outside the National Park Service, unless a signed confidentiality agreement is in place.
- In general, if information is withheld from one requesting party, it must be withheld from anyone else who requests it, and if information is provided to one requesting party without a confidentiality agreement, it must be provided to anyone else who requests it.
- To share information as broadly as legally possible, and to provide a consistent, tractable approach for handling sensitive information, the following shall apply if a project is likely to collect and store sensitive information:

- Random coordinate offsets of up to 2 km for data collection locations, and
- Removal of data fields likely to contain sensitive information from released data set copies.

What Kinds of Information Can and Cannot Be Shared?

Do not share: Project staff and cooperators should not share any information outside NPS that reveals details about the "nature or specific location" of protected resources, unless a confidentiality agreement is in place. Specifically, the following information should be omitted from shared copies of all data, presentations, reports, or other published forms of information.

- *Exact coordinates* – Instead, public coordinates are to be generated that include a random offset azimuth and distance. These offset coordinates can be shared freely.
- *Other descriptive location data* – Examples may include travel descriptions, location descriptions, or other fields that contain information that may reveal the specific location of the protected resource(s).
- *Protected resource observations at disclosed locations* – If specific location information has already been made publicly available, the occurrence of protected resources at that location cannot be shared outside NPS without a confidentiality agreement. For example, if the exact coordinates for a monitoring station location are posted to a website or put into a publication, then at a later point in time a spotted owl nest is observed at that monitoring station, that nest cannot be mentioned or referred to in any report, presentation, data set, or publication that will be shared outside NPS.

Do share: All other information about the protected resource(s) may be freely shared, so long as the information does not reveal details about the "nature or specific location" of the protected resource(s) that are not already readily available to the general public in some form (e.g., other published material). Species tallies and other types of data presentations that do not disclose the precise locations of protected resources may be shared, unless by indicating the presence of the species the specific location is also revealed (e.g., in the case of a small park).

Details for Specific Products

Whenever products such as databases and reports are being generated, handled and stored, they should be created explicitly for one of the following purposes:

1. *Public or general-use* – Intended for general distribution, sharing with cooperators, or posting to public websites. They may be derived from products that contain sensitive information so long as the sensitive information is either removed or otherwise rendered in a manner consistent with other guidance in this document.
2. *Internal NPS use* – These are products that contain sensitive information and should be stored and distributed only in a manner that ensures their continued protection. These products should clearly indicate that they are solely for internal NPS use by containing the phrase: "Internal NPS Use Only – Not For Release." These products can only be shared within NPS or in cases where a confidentiality agreement is in place. They do not need to be revised in a way that conceals the location of protected resources.

Data Sets

To create a copy of a data set that will be posted or shared outside NPS:

1. Make sure the public offset coordinates have been populated for each sample or observation location in tbl_Locations.
2. Delete all data from the following database objects to ensure consistent omission of fields that may contain specific, identifying information about locations of protected resources:
    a. tbl_Coordinates – delete all records
    b. tbl_GPS_Info – delete all records
    c. tbl_Locations – Travel_notes, Location_desc, and Location_notes
    d. tbl_Target_Coords – Target_UTME and Target_UTMN

The local, master copy of the database contains the exact coordinates and all data fields. The Data Manager and/or GIS Specialist can provide technical assistance as needed to apply coordinate offsets or otherwise edit data products for sensitive information.

Maps and Other GIS Output

General-use maps and other geographic representations of observation data that will be released or shared outside NPS should be rendered using offset coordinates, and should only be rendered at a scale that does not reveal their exact position (e.g., 1:100,000 maximum scale).

If a large-scale, close-up map is to be created using exact coordinates (e.g., for field crew navigation, etc.), the map should be clearly marked with the following phrase: "Internal NPS Use Only – Not For Release."

The Data Manager and/or GIS Specialist can provide technical assistance as needed to apply coordinate offsets or otherwise edit data products for sensitive information.

Presentations and Reports

Public or general-use reports and presentations should adhere to the following guidelines:

1. Do not list exact coordinates or specific location information in any text, figure, table, or graphic in the report or presentation. If a list of coordinates is necessary, use only offset coordinates and clearly indicate that coordinates have been purposely offset to protect the resource(s) as required by law and NPS policy.
2. Use only general-use maps as specified in the section on maps and other GIS output.

If a report is intended for internal use only, these restrictions do not apply. However, each page of the report should be clearly marked with the following phrase: "Internal NPS Use Only – Not For Release."

Voucher Specimens

Specimens of protected taxa should only be collected as allowed by law. Labels for specimens should be clearly labeled as containing sensitive information by containing the following phrase: "Internal NPS Use Only – Not For Release." These specimens should be stored separately from other specimens to prevent unintended access by visitors. As with any sensitive information, a

confidentiality agreement should be in place prior to sending these specimens to another non-NPS cooperator or collection.

Procedures for Coordinate Offsets

1. Process GPS data, upload into the database, and finalize coordinate data records. Update tbl_Coordinates.Is_best as appropriate, especially where there is more than one set of coordinates per sample location.
2. Set the minimum and maximum offset distances (project-specific, typically up to 2 km).
3. Apply a random offset and random azimuth to each unique set of coordinates.
4. Coordinates may then be either rounded or truncated so the UTM values end in zeros to give a visual cue that the values are not actual coordinates.
5. Do not apply independent offsets to clustered or otherwise linked sample locations (e.g., multiple sample points along a transect). Instead, either apply a single offset to the cluster so they all remain clustered after the offset is applied, or apply an offset to only one of the points in the cluster (e.g., the transect origin) and store the result in the public coordinates for each point in that cluster.
6. These "public" coordinates are then the only ones to be shared outside NPS – including all published maps, reports, publications, presentations, and distribution copies of the data set – in the absence of a confidentiality agreement.

The following components can be used to create individual offsets rounded to the nearest 100 m in Microsoft Excel:

- Angle = rand() * 359
- Distance = ((Max_offset – Min_offset) * rand() + Min_offset)
- Public_UTME = Round(UTME_final + (Distance * cos(radians(Angle – 90)), -2)
- Public_UTMN = Round(UTMN_final + (Distance * sin(radians(Angle + 90))), -2)

Sharing Sensitive Information

Note: Refer to **SOP 13: Product Delivery, Posting and Distribution** for a more complete description of how to post and distribute products, and to keep a log of data requests.

No sensitive information (e.g., information about the specific nature or location of protected resources) may be posted to the NPS Data Store or any other publicly-accessible website, or otherwise shared or distributed outside NPS without a confidentiality agreement between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared. Only products that are intended for public/general-use may be posted to public websites and clearinghouses – these may not contain sensitive information.

Responding to Data Requests

If requests for distribution of products containing sensitive information are initiated by the NPS, by another federal agency, or by another partner organization (e.g., a research scientist at a university), the unedited product (e.g., the full data set that includes sensitive information) may only be shared after a confidentiality agreement is established between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared. All data requests

will be tracked according to procedures in **SOP 13: Product Delivery, Posting and Distribution**.

Once a confidentiality agreement is in place, products containing sensitive information may be shared following these guidelines:

- Always clearly indicate in accompanying correspondence that the products contain sensitive information, and specify which products contain sensitive information.
- Indicate in all correspondence that products containing sensitive information should be stored and maintained separately from non-sensitive information, and protected from accidental release or re-distribution.
- Indicate that NPS retains all distribution rights; copies of the data should not be redistributed by anyone but NPS.
- Include the following standard disclaimer in a text file with all digital media upon distribution: "The following files contain protected information. This information was provided by the National Park Service under a confidentiality agreement. It is not to be published, handled, re-distributed or used in a manner inconsistent with that agreement." The text file should also specify the file(s) containing sensitive information.
- If the products are being sent on physical media (e.g., CD or DVD), the media should be marked in such a way that clearly indicates that media contains sensitive information provided by the National Park Service.

Confidentiality Agreements

Confidentiality agreements may be created between NPS and another organization or individual to ensure that protected information is not inadvertently released. When contracts or other agreements with a non-federal partner do not include a specific provision to prevent the release of protected information, the written document must include the following standard Confidentiality Agreement:

> **Confidentiality Agreement** - I agree to keep confidential any protected information that I may develop or otherwise acquire as part of my work with the National Park Service. I understand that with regard to protected information, I am an agent of the National Park Service and must not release that information. I also understand that by law I may not share protected information with anyone through any means except as specifically authorized by the National Park Service. I understand that protected information concerns the nature and specific location of endangered, threatened, rare, commercially valuable, mineral, paleontological, or cultural patrimony resources such as threatened or endangered species, rare features, archeological sites, museum collections, caves, fossil sites, gemstones, and sacred ceremonial sites. Lastly, I understand that protected information must not be inadvertently disclosed through any means including websites, maps, scientific articles, presentation, and speeches.

Note: Certain states, including the State of Washington, have sunshine laws that do not have exemptions for sensitive information. NPS should not create confidentiality agreements or share sensitive information with these states without first seeking the advice of an NPS solicitor.

Freedom of Information (FOIA) Requests

All official FOIA requests will be handled according to NPS policy. The Project Lead will work with the Data Manager and the park FOIA representative(s) of the park(s) for which the request applies.

Literature Cited

National Park Service. 2006. Management Policies. Available at: http://www.nps.gov/policy/mp/policies.html (accessed 5 May 2010).

SOP 15: Revising the Protocol

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP describes how to make and track changes to the NCCN Prairie Vegetation Monitoring Protocol, including its accompanying SOPs. Project staff should refer to this SOP whenever edits are necessary, and should be familiar with the protocol versioning conventions in order to identify and use the most current versions of the protocol documents. Required revisions should be made in a timely manner to minimize disruptions to project operations.

Peer Review

This protocol attempts to incorporate the best and most cost-effective methods for monitoring and information management. As new technologies, methods, and equipment become available, this protocol will be updated as appropriate, by balancing current best practices against the continuity of protocol information.

All edits require review for clarity and technical soundness. Small changes to existing documents – e.g., formatting, simple clarification of existing content, minor changes to the task schedule or project budget, or general updates to information management SOPs – may be reviewed in-house by project and NCCN staff. However, changes to data collection or analysis techniques, sampling design, or response design are usually more significant in scope and impact and will typically trigger an outside review to be coordinated by the Pacific West Regional Office of the National Park Service.

Document Life Cycle

Protocol documents may be maintained as separate files for each component (e.g., narrative, SOPs, appendices in separate document files) or unified into a single document file. During its life cycle, each document file can be classified in one of six life cycle stages:

1. Draft documents – Documents that have been drafted or revised but have not been reviewed and approved yet.
2. Review documents – Draft documents that have been sent out for peer review or administrative review.
3. Active documents – The current, reviewed and accepted version of each protocol component in Microsoft Word format. These documents have been reviewed and

approved at the appropriate level, and are currently implemented for active monitoring projects.
4. Inactive documents – Older versions of approved protocol components that are no longer in active implementation.
5. Archived documents – Comprehensive set of active protocol components plus older, inactive versions of approved protocol components in Microsoft Word format. These are stored as read-only and have a date stamp to identify their approval date. The history of the protocol versions through time should be entirely traceable from within the document archive.
6. Distribution copies – PDF versions of approved, date-stamped protocol components, used to post to websites or otherwise share outside NPS.

Protocol documents are stored in the project workspace in separate subfolders named for each life cycle stage, except for inactive documents which are filed together with date-stamped copies of active documents in the archive folder. See **SOP 1: Project Workspace and Records Management** for additional details about the project workspace.

Document Versioning Conventions

Rather than using a sequential numeric versioning convention, we use date stamps to distinguish document versions because they are more intuitive and informative than version numbers. Date stamps are embedded within the document header and are also included in the document name.

Document Header

Within each document, the upper right section of the document header should show the date that the document was last saved. By using save date instead of current date, printouts and document previews will show the correct version number. The following is the field code to be used within the header to indicate the version number:

SAVEDATE } \@ "MMMM d, yyyy"

File Naming Conventions

All documents *except for active documents and draft documents* should include the last edit date as a suffix, using the YYYYMMDD format so that documents will sort by date rather than month or day (e.g., NCCN_Prairie_Protocol_DRAFT_20110523.docx for the review draft on 5/23/2011).

Active documents and draft documents that have not been shared with others (as review documents) should not include the date because – unlike documents in other life cycle stages – they are not "point in time" document snapshots. By omitting the date stamp from these documents, they can more easily be distinguished from review drafts and archive or distribution copies. Draft documents should clearly contain the word "DRAFT" in the file name.

Note: General file and folder naming conventions are described in **SOP 1: Project Workspace and Records Management**; these should be followed when naming protocol document files.

Revision Procedures

Proposed changes to protocol components should be discussed among project staff prior to making modifications. It is especially important to consult with the Data Manager prior to making changes because certain types of changes may jeopardize data set integrity unless they are planned and executed with the continuity of the data set in mind. Because certain changes may require altering the database structure or functionality, advance notice of changes is important to minimize disruptions to project operations. Consensus should be reached on who will be making the agreed-upon changes and in what timeframe.

Note: A change in one document also may necessitate other changes elsewhere in the protocol. For example, a change in the narrative may require changes to several SOPs; similarly renumbering an SOP may mean changing document references in several other sections of the protocol. The project task list and other appendices also may need to be updated to reflect changes in timing or responsibilities for the various project tasks.

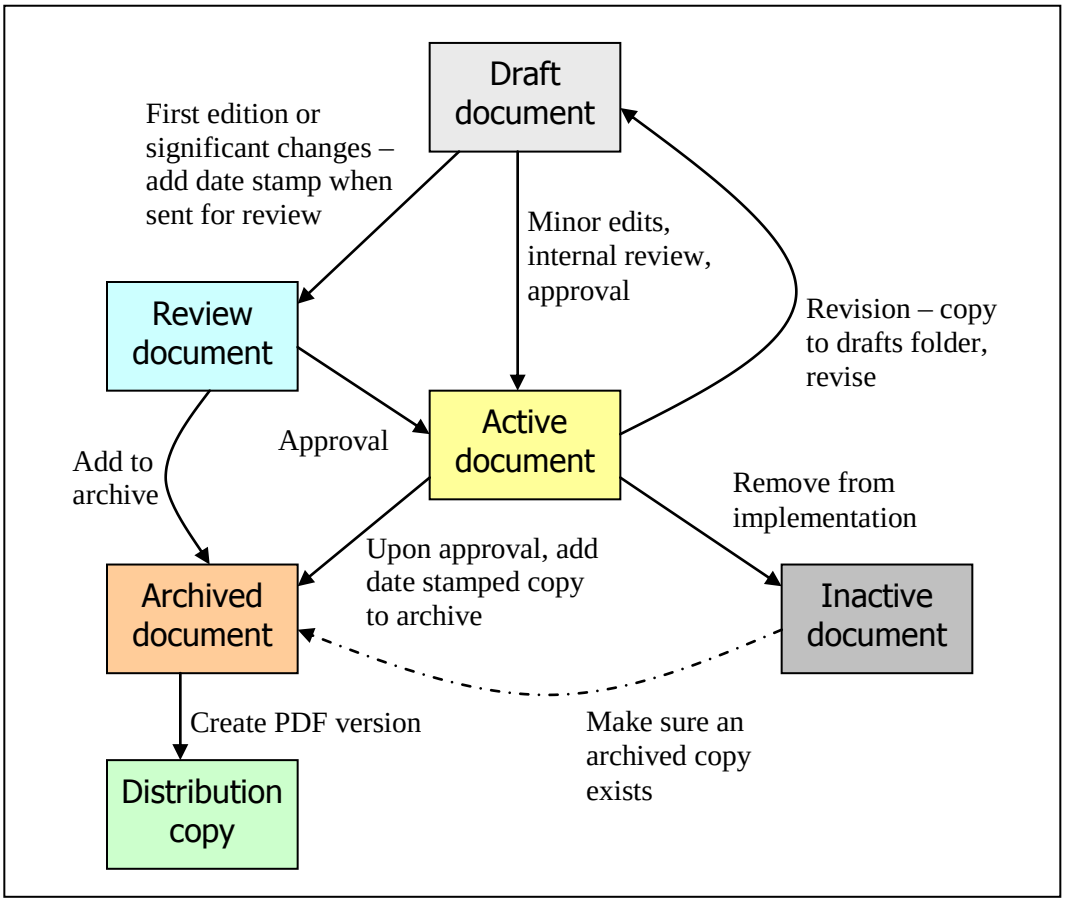


Figure 15.1. Process for creating and revising protocol documents. Boxes represent document life cycle stages, and connecting arrows indicate procedures.

The Project Lead is the primarily responsible for making edits and ensuring document review at the appropriate level. The process for creating and revising protocol documents is shown in Figure 15.1, and outlined below:

1. Create the draft document in Microsoft Word format. If modifying an existing document (usually an active document), copy the document to the draft document folder, remove any date stamp from the name. Add "DRAFT" to the file name. Open the document and add "DRAFT" to the header or document watermark as appropriate.

2. Track revision history. If modifying an existing document, document all edits in the Revision History Log embedded in the protocol narrative and each SOP. Log changes only for the section of the document being edited (i.e., if there is a change to an SOP, log those changes only in the revision history log for that SOP). Record the date of the changes (i.e., the date on which all changes were finalized), author of the revision, describe the change and cite the paragraph(s) and page(s) where changes are made, and briefly indicate the reason for making the changes.

3. Document review. Circulate the changed document for internal review among project staff and cooperators. If the changes are significant enough to trigger peer review (as defined above), create a review document by adding a date stamp to the end of the file name using the YYYYMMDD format, copy the file to the archive folder, and submit the document for peer review according to current instructions.

4. Finalize and archive. Upon approval and final changes:
   a. Ensure that the version date (last saved date field code in the document header) and file name (field code in the document footer, if used) are updated properly throughout the document.
   b. Move the approved document to the active folder. Remove the word "DRAFT" from watermarks, document headers, and file name. Remove any previous date stamp. This is now an active, implemented document.
   c. To avoid unplanned edits to the document, reset the document to read-only by right-clicking on the document in Windows Explorer and checking the appropriate box in the Properties popup.
   d. Create a copy of the file and add the revision date to the end of the file name using the YYYYMMDD format. Move this copy to the archive folder.
   e. Inform the Data Manager so the new version number can be incorporated into the project metadata.

5. Create distribution copies. As needed, create a PDF version of the archived document to post to the internet and share with others. These PDF versions should have the same date-stamped name as the archived Microsoft Word file. Post the distribution copy to the NCCN Digital Library and forward copies to all individuals who had been using a previous version of the affected document.

6. Remove from implementation. If it is decided that a document needs to be removed from implementation – either because it is no longer necessary (e.g., an unneeded SOP), or because it has been superseded by a more recent version – this can be easily done by

removing the document from the active document folder, after first checking that a copy of that version already exists in the archive folder.

Appendix A. Administrative Record

Table A1. Prairie Protocol Administrative History.

Date	Event	Discussion/Decision
March 20-22, 2001	Vital Signs Workshop, SAJH	Issues identified for monitoring: • Landscape change – exotics, vegetation cover types, external development • Changes in vegetation structure and composition • What is the status and distribution of rare vascular and non-vascular species in the park? • What is the effect of exotic plant species on park vegetation communities? • What is the condition of prairie plant communities?
June 5-7, 2001	Vital Signs Workshop, FOVA	Issues identified for monitoring or research: • Can prairies be restored at FOVA? • What are the risks of erosion on agricultural areas?
June 19-21, 2001	Vital Signs Workshop, EBLA	Issues identified for monitoring: • What is the park's desired future condition with respect to proportion of the landscape that is natural vegetation, agricultural, and developed? • Where can native prairies be restored? • Monitoring of rare vascular plant species • What is the status of wetlands in EBLA
November 15, 2001	Vegetation Workgroup Meeting	Summarized all research and monitoring questions and identified priorities for vegetation workgroup: forests, subalpine, and prairies.
2000-2001	FOVA Vascular Plant Inventory	Inventory conducted documenting that although a few native plants existed in the prairies, the parks need was for prairie restoration rather than monitoring of extant native prairies.
2001-2002	SAJH Vascular Plant Inventory	Field work for vascular plant inventory documented about 87 native plant polygons; goals for prairie monitoring now focused on condition of native patches in addition to invasive introduced plants.
2002-2005	EBLA Vascular Plant Inventory	Field work documented some occurrences of native plants, but all native communities were on property managed by Au Sable. Park need was discussed, following inventories, with EBLA Natural Resource Specialist and recommendation that work should focus on restoration methods rather than monitoring extant native prairies.
December 2005	Initiated statistics contract with West, Inc.	Identified stages of project: • Review NPS identified qualitative monitoring questions and objectives • Develop quantitative monitoring objectives • Develop sample design, field methods, and analysis methods
February 15, 2006	Monitoring Objectives	Discussion between West, Inc (Lyman McDonald), Regina Rochefort and Anne Braaten (GIS Specialist) regarding: • Review of qualitative monitoring questions • How to monitor native prairie patches located during inventory • Sample frame • Use of GIS layers of park and prairie patches for computer simulations of sample size

Table A1. Prairie Protocol Administrative History (continued).

Date	Event	Discussion/Decision
February 21, 2006	Monitoring Objectives, Sample Frame	Recommendations/Decisions • Protocol will focus on SAJH but can be directly applied to FOVA and EBLA when prairies are restored/developed • Pilot work will focus on American Camp • West (Lyman McDonald) suggests monitoring all landscape cover types so that prairie cover is put in the context of the entire park landscape and as change occurs in the future, we can monitor changes in prairie distribution • Monitoring questions articulated • Two-stage sampling design recommended • Discussion initiated on how to monitor native prairie patches – McDonald recommends transects and not mapping of patch perimeters
March 1, 2006	Transect Simulation Plan	West submits draft of simulation plan for number of transects and panel design (1 annual panel and 5 rotating panels) to monitor distribution of vegetation cover types
May 2006	Pilot work	• Conducted pilot studies to determine if transect monitoring with GPS was feasible. • Determined transects and GPS cover was feasible, but cover types needed major revisions
2006-2008	Evaluation of Aerial Photo Method	• Winter 2006, R. Rochefort worked with Alan McCoy and Craig Dalby of PWRO to identify map cover types and resolve with field types • Winter 2006 – McCoy starts work on 1997 aerial photos and American and English Camp, Dalby issues contract for new aerial photos • New photos flown in June 2007 • McCoy and Dalby recommendations indicate aerial photos cannot monitor some of the changes we are interested in • Report submitted by McCoy and Dalby • Decision made to use field monitoring rather than aerial photos
2007-2009	Pilot field work	• Field methods revised • Field methods for transects tested by multiple seasonal employees and by the NCCN vegetation group • Number of transects for American Camp increased from 30 to 45 in 2008 to improve assessment of status
2009-2010	Analysis	• Refined monitoring questions for vegetation composition • Utilized inventory field data for sample size and power analysis • West, Inc. submits annual and rotating panel of transects for monitoring distribution of vegetation cover types at English Camp
July 2010	Submitted protocol	Wrote protocol and submitted to internal (NPS) review (vegetation group and SAJH staff)

Appendix B. Plant Species of San Juan Island National Historical Park

Growth Form	Scientific Name	Common Name	Origin	Species Code	Coefficient of Conservatism[1]	Weed Score[1]
Forb	*Abronia latifolia*	Coastal Sand Verbena	N	ABRLAT	4	
Forb	*Achillea millefolium var. occidentalis*	Western Yarrow	N	ACHMILOCC	3	
Forb	*Adenocaulon bicolor*	American Trailplant	N	ADEBIC	4	
Forb	*Allium acuminatum*	Tapertip Onion	N	ALLACU	5	
Forb	*Allium cernuum*	Nodding Onion	N	ALLCER	4	
Forb	*Ambrosia chamissonis*	Silver Bur Ragweed	N	AMBCHA	3	
Forb	*Amsinckia menziesii*	Menzies' Fiddleneck	N	AMSMEN	2	
Forb	*Amsinckia menziesii var. intermedia*	Common Fiddleneck	N	AMSMENINT	2	
Forb	*Anagallis arvensis*	Scarlet Pimpernel	E	ANAARV	*	-2
Forb	*Anaphalis margaritacea*	Western Pearly Everlasting	N	ANAMAR	2	
Forb	*Aquilegia formosa*	Western Columbine	N	AQUFOR	4	
Forb	*Arabidopsis thaliana*	Mouse-ear Cress	E	ARATHA	*	-1
Forb	*Arctium minus*	Lesser Burdock	E	ARCMIN	*	-2
Forb	*Argentina egedii ssp. egedii*	Pacific Silverweed	N	ARGEGEEGE	3	
Forb	*Armeria maritima ssp. sibirica*	Siberian Sea Thrift	N	ARMMARSIB	6	
Forb	*Asplenium trichomanes-ramosum*	Brightgreen Spleenwort	N	ASPTRIRAM	9	
Forb	*Athyrium filix-femina*	Common Ladyfern	N	ATHFIL	4	
Forb	*Atriplex gmelinii*	Gmelin's Saltbrush	N	ATRGME	5	
Forb	*Atriplex patula*	Spear Saltbrush	E	ATRPAT	*	-1
Forb	*Atriplex patula ssp. patula*	Spear Saltbrush	E	ATRPATPAT	*	-1
Forb	*Atriplex prostrata*	Triangle Orache	E	ATRPRO	*	-1
Forb	*Barbarea orthoceras*	American Yellowrocket	N	BARORT	3	
Forb	*Bellis perennis*	Lawndaisy	E	BELPER	*	-3
Forb	*Brassica rapa ssp.campestris*	Common Mustard	E	BRARAPCAM	*	-3
Forb	*Brodiaea coronaria ssp. coronaria*	Crown Brodiaea	N	BROCORCOR	5	
Forb	*Cakile maritima*	European Searocket	E	CAKMAR	*	-2
Forb	*Callitriche heterophylla ssp. bolanderi*	Bolander's Water-Starwort	N	CALHETBOL	6	
Forb	*Calypso bulbosa*	Fairy Slipper	N	CALBUL	7	

Growth Form	Scientific Name	Common Name	Origin	Species Code	Coefficient of Conservatism[1]	Weed Score[1]
Forb	*Calystegia soldanella*	Seashore False Bindweed	N	CALSOL	5	
Forb	*Camassia leichtlinii ssp. suksdorfii*	Suksdorf's Large Camas	N	CAMLEISUK	5	
Forb	*Camassia quamash*	Common Camas	N	CAMQUA	3	
Forb	*Camissonia contorta*	Plains Evening Primrose	N	CAMCON	5	
Forb	*Campanula scouleri*	Pale Bellflower	N	CAMSCO	4	
Forb	*Capsella bursa-pastoris*	Shepherd's Purse	E	CAPBUR	*	-2
Forb	*Cardamine hirsuta*	Hairy Bittercress	E	CARHIR	*	-2
Forb	*Cardamine oligosperma var. oligosperma*	Little Western Bittercress	N	CAROLIOLI	1	
Forb	*Cardamine pensylvanica*	Pennsylvania Bittercress	N	CARDPEN	1	
Forb	*Castilleja attenuata*	Attenuate Indian Paintbrush	N	CASATT	5	
Forb	*Castilleja hispida ssp. hispida*	Harsh Indian Paintbrush	N	CASHISHIS	6	
Forb	*Centaurium erythraea*	European Centaury	E	CENERY	*	-2
Forb	*Cerastium arvense*	Field Chickweed	N	CERARV	4	
Forb	*Cerastium fontanum*	Common Mouse-Ear Chickweed	E	CERFON	*	-1
Forb	*Cerastium glomeratum*	Sticky Chickweed	E	CERGLO	*	-1
Forb	*Chamerion angustifolium ssp. angustifolium*	Fireweed	N	CHAANGANG	2	
Forb	*Chenopodium album*	Lambsquarters	E	CHEALB	*	-2
Forb	*Chenopodium leptophyllum*	Narrowleaf Goosefoot	N	CHELEP	5	
Forb	*Cichorium intybus*	Chicory	E	CICINT	*	-3
Forb	*Cicuta douglasii*	Western Water Hemlock	N	CICDOU	4	
Forb	*Circaea alpina*	Small Enchanter's Nightshade	N	CIRALP	3	
Forb	*Cirsium arvense*	Canada Thistle	E	CIRARV	*	-3
Forb	*Cirsium vulgare*	Bull Thistle	E	CIRVUL	*	-3
Forb	*Claytonia perfoliata ssp. perfoliata*	Miner's Lettuce	N	CLAPERPER	6	
Forb	*Claytonia rubra ssp. rubra*	Redstem Springbeauty	N	CLARUBRUB	4	
Forb	*Claytonia sibirica var. sibirica*	Siberian Springbeauty	N	CLASIBSIB	2	
Forb	*Clinopodium douglasii*	Yerba Buena	N	CLIDOU	4	
Forb	*Clintonia uniflora*	Bride's Bonnet	N	CLIUNI	6	
Forb	*Collinsia parviflora var. parviflora*	Smallflower Blue Eyed Mary	N	COLPARPAR	3	

Growth Form	Scientific Name	Common Name	Origin	Species Code	Coefficient of Conservatism[1]	Weed Score[1]
Forb	*Corallorrhiza maculata*	Summer Coralroot	N	CORMAC	6	
Forb	*Corallorrhiza mertensiana*	Pacific Coralroot	N	CORMER	7	
Forb	*Corallorrhiza striata*	Hooded Coralroot	N	CORSTR	7	
Forb	*Cornus canadensis*	Bunchberry Dogwood	N	CORCAN	5	
Forb	*Crassula connata*	Sand Pygmyweed	N	CRACON	4	
Forb	*Crepis capillaris*	Smooth Hawksbeard	E	CRECAP	*	-3
Forb	*Cryptantha intermedia*	Clearwater Cryptantha	E	CRYINT	*	-3
Forb	*Cuscuta salina*	Saltmarsh Dodder	N	CUSSAL	5	
Forb	*Cymbalaria muralis*	Kenilworth Ivy	E	CYMMUR	*	-3
Forb	*Daucus carota*	Queen Anne's Lace	E	DAUCAR	*	-3
Forb	*Delphinium menziesii ssp. menziesii*	Menzies' Larkspur	N	DELMENMEN	6	
Forb	*Dianthus armeria*	Deptford Pink	E	DIAARM	*	-3
Forb	*Digitalis purpurea var. purpurea*	Purple Foxglove	E	DIGPURPUR	*	-2
Forb	*Dipsacus fullonum ssp. sylvestris*	Fuller's Teasel	E	DIPFULSYL	*	-3
Forb	*Dodecatheon hendersonii*	Mosquito Bills	N	DODHEN	5	
Forb	*Draba verna*	Spring Whitlow Grass	E	DRAVER	*	-1
Forb	*Dryopteris expansa*	Spreading Woodfern	N	DRYEXP	5	
Forb	*Epilobium ciliatum ssp. ciliatum*	Fringed Willowherb	N	EPICILCIL	2	
Forb	*Epilobium ciliatum ssp. watsonii*	Fringed Willowherb	N	EPICILWAT	3	
Forb	*Epilobium minutum*	Chaparral Willowherb	N	EPIMIN	4	
Forb	*Equisetum arvense*	Field Horsetail	N	EQUARV	1	
Forb	*Equisetum hyemale*	Scouringrush Horsetail	N	EQUHYE	1	
Forb	*Equisetum telmateia var. braunii*	Giant Horsetail	N	EQUTELBRA	3	
Forb	*Erodium cicutarium*	Redstem Stork's Bill	E	EROCIC	*	-1
Forb	*Erythronium oregonum*	Giant White Fawnlily	N	ERYORE	5	
Forb	*Eschscholzia californica*	California Poppy	E	ESCCAL	*	-2
Forb	*Fragaria chiloensis*	Beach Strawberry	N	FRACHI	4	
Forb	*Fragaria vesca ssp. bracteata*	Woodland Strawberry	N	FRAVESBRA1	3	
Forb	*Fragaria virginiana*	Virginia Strawberry	N	FRAVIR	3	
Forb	*Fritillaria affinis*	Checker Lily	N	FRIAFF	5	

Growth Form	Scientific Name	Common Name	Origin	Species Code	Coefficient of Conservatism[1]	Weed Score[1]
Forb	*Galium aparine*	Stickywilly	N	GALAPA	2	
Forb	*Galium tricornutum*	Roughfruit Corn Bedstraw	E	GALTRIC	*	-1
Forb	*Galium trifidum ssp. columbianum*	Threepetal Bedstraw	N	GALTRIDCOL	4	
Forb	*Galium triflorum*	Fragrant Bedstraw	N	GALTRILFLO	3	
Forb	*Geranium dissectum*	Cutleaf Geranium	E	GERDIS	*	-2
Forb	*Geranium molle*	Dovefoot Geranium	E	GERMOL	*	-2
Forb	*Geranium robertianum*	Robert Geranium	E	GERROB	*	-3
Forb	*Geum macrophyllum var. macrophyllum*	Largeleaf Avens	N	GEUMACMAC	3	
Forb	*Gnaphalium purpureum*	Spoonleaf Purple Everlasting	N	GNAPUR	3	
Forb	*Goodyera oblongifolia*	Western Rattlesnake Plantain	N	GOOOBL	5	
Forb	*Grindelia hirsutula*	Oregon Gumweed	N	GRIHIR	2	
Forb	*Hedera helix*	English Ivy	E	HEDHEL	*	-3
Forb	*Heliopsis helianthoides*	Smooth Oxeye	N	HELHEL	3	
Forb	*Heracleum maximum*	Common Cowparsnip	N	HERMAX	3	
Forb	*Heuchera micrantha var. diversifolia*	Crevice Alumroot	N	HEUMICDIV	6	
Forb	*Hieracium albiflorum*	White Hawkweed	N	HIEALB	3	
Forb	*Hippuris vulgaris*	Common Mares-tail	N	HIPVUL	5	
Forb	*Honckenya peploides ssp. major*	Seaside Sandplant	N	HONPEPMAJ	4	
Forb	*Hyacinthoides hispanica*	Scilla	E	HYAHIS	*	-2
Forb	*Hypericum scouleri ssp. scouleri*	Scouler's St. Johnswort	N	HYPSCOSCO	4	
Forb	*Hypochaeris glabra*	Smooth Cat's Ear	E	HYPGLA	*	-3
Forb	*Hypochaeris radicata*	Hairy Cat's Ear	E	HYPRAD	*	-3
Forb	*Jaumea carnosa*	Marsh Jaumea	N	JAUCAR	4	
Forb	*Lamium purpureum*	Red Dead-nettle	E	LAMPUR	*	-2
Forb	*Lapsana communis*	Common Nipplewort	E	LAPCOM	*	-1
Forb	*Lathyrus japonicas var. maritimus*	Beach Pea	N	LATJAPMAR	4	
Forb	*Lathyrus nevadensis var. nevadensis*	Sierra Pea	N	LATNEVNEV	4	
Forb	*Lathyrus nevadensis var. pilosellus*	Sierra Pea	N	LATNEVPIL	4	
Forb	*Lemna minor*	Common Duckweed	N	LEMMIN	2	
Forb	*Leontodon autumnalis*	Fall Dandelion	E	LEOAUT	*	-3

Growth Form	Scientific Name	Common Name	Origin	Species Code	Coefficient of Conservatism[1]	Weed Score[1]
Forb	*Leontodon hirtus*	Rough Hawkbit	E	LEOHIR	*	-3
Forb	*Lepidium densiflorum*	Common Pepperweed	N	LEPDEN	4	
Forb	*Lepidium virginicum var. menziesii*	Menzies' Pepperweed	N	LEPVIRMEN	3	
Forb	*Leucanthemum vulgare*	Oxeye Daisy	E	LEUVUL	*	-3
Forb	*Leptosiphon bicolor*	True Babystars	N	LEPBIC	4	
Forb	*Linnaea borealis ssp. longiflora*	Longtube Twinflower	N	LINBORLON1	5	
Forb	*Listera cordata*	Heartleaf Twayblade	N	LISCOR	6	
Forb	*Lithophragma parviflorum*	Smallflower Woodland-Star	N	LITPAR	5	
Forb	*Logfia arvensis*	Field Cottonrose	E	LOGARV	*	-1
Forb	*Lomatium nudicaule*	Barestem Biscuitroot	N	LOMNUD	4	
Forb	*Lomatium utriculatum*	Common Lomatium	N	LOMUTR	5	
Forb	*Lonicera ciliosa*	Orange Honeysuckle	N	LONCIL	4	
Forb	*Lonicera hispidula*	Pink Honeysuckle	N	LONHIS	4	
Forb	*Lotus micranthus*	Desert Deervetch	N	LOTMIC	3	
Forb	*Lupinus bicolor ssp. bicolor*	Miniature Lupine	N	LUPBICBIC	2	
Forb	*Lupinus densiflorus var. densiflorus*	Whitewhorl Lupine	N	LUPDENDEN	4	
Forb	*Lupinus latifolius*	Broadleaf Lupine	N	LUPLAT	5	
Forb	*Lupinus littoralis*	Seashore Lupine	N	LUPLIT	5	
Forb	*Lupinus polycarpus*	Smallflower Lupine	N	LUPPOL	3	
Forb	*Lychnis coronaria*	Rose Campion	E	LYCCOR	*	-2
Forb	*Lysichiton americanus*	American Skunkcabbage	N	LYSAME	4	
Forb	*Madia madioides*	Woodland Madia	N	MADMAD	3	
Forb	*Madia sativa*	coast tarweed	N	MADSAT	3	
Forb	*Maianthemum dilatatum*	False Lily Of The Valley	N	MAIDIL	4	
Forb	*Maianthemum stellatum*	Starry False Lily Of The Valley	N	MAISTE	4	
Forb	*Marah oreganus*	Coastal Manroot	N	MARORE	3	
Forb	*Matricaria discoidea*	Disc Mayweed	E	MATDIS	*	-1
Forb	*Medicago lupulina*	Black Medick	E	MEDLUP	*	-1
Forb	*Medicago sativa*	Alfalfa	E	MEDSAT	*	-1
Forb	*Melilotus alba*	Yellow Sweetclover	E	MELALB	*	-3

Growth Form	Scientific Name	Common Name	Origin	Species Code	Coefficient of Conservatism[1]	Weed Score[1]
Forb	*Mentha arvensis*	Wild Mint	N	MENARV	3	
Forb	*Mimulus guttatus*	Seep Monkeyflower	N	MIMGUT	3	
Forb	*Moehringia macrophylla*	Largeleaf Sandwort	N	MOEMAC	5	
Forb	*Monotropa uniflora*	Indian Pipe	N	MONOUNI	7	
Forb	*Montia parvifolia*	Littleleaf Minerslettuce	N	MONPAR	3	
Forb	*Montia parvifolia ssp. flagellaris*	Littleleaf Minerslettuce	N	MONPARFLA	5	
Forb	*Mycelis muralis*	Wall-Lettuce	E	MYCMUR	*	-1
Forb	*Myosotis discolor*	Changing Forget-Me-Not	E	MYODIS	*	-3
Forb	*Myosotis laxa*	Bay Forget-Me-Not	N	MYOLAX	3	
Forb	*Nemophila parviflora var. parviflora*	Smallflower Nemophila	N	NEMPARPAR	4	
Forb	*Oenanthe sarmentosa*	Water Parsely	N	OENSAR	3	
Forb	*Olsynium douglasii var. douglasii*	Grass widows	N	OLSDOUDOU	5	
Forb	*Osmorhiza berteroi*	Sweet cicely	N	OSMBER	4	
Forb	*Osmorhiza purpurea*	Purple Sweetroot	N	OSMPUR	4	
Forb	*Papaver somniferum*	Opium Poppy	E	PAPSOM	*	-3
Forb	*Parentucellia viscosa*	Yellow Glandweed	E	PARVIS	*	-3
Forb	*Pentagramma triangularis ssp. triangularis*	Goldback Fern	N	PENTRITRI	7	
Forb	*Piperia elegans ssp. elegans*	Elegant Piperia	N	PIPELEELE	6	
Forb	*Piperia unalascensis*	Slender-Spire Orchid	N	PIPUNA	6	
Forb	*Plantago lanceolata*	Narrowleaf Plantain	E	PLALAN	*	-1
Forb	*Plantago major*	Common Plantain	E	PLAMAJ	*	-1
Forb	*Plantago major var. major*	Common Plantain	E	PLAMAJMAJ	*	-1
Forb	*Plantago maritima var. juncoides*	Goose Tongue	N	PLAMARJUN	6	
Forb	*Plectritis congesta*	Shortspur Seablush	N	PLECON	4	
Forb	*Polygonum aviculare*	Prostrate Knotweed	E	POLAVI	*	-3
Forb	*Polygonum douglasii ssp. spergulariiforme*	Scatter Knotweed	N	POLDOUSPE	2	
Forb	*Polypodium amorphum*	Irregular Polypody	N	POLAMO	5	
Forb	*Polypodium glycyrrhiza*	Licorice Fern	N	POLGLY	5	
Forb	*Polystichum munitum*	Western Swordfern	N	POLMUN	3	

Growth Form	Scientific Name	Common Name	Origin	Species Code	Coefficient of Conservatism[1]	Weed Score[1]
Forb	*Prunella vulgaris ssp. lanceolata*	Lance Selfheal	E	PRUVULLAN1	*	-1
Forb	*Pteridium aquilinum var. pubescens*	Hairy Brackenfern	N	PTEAQUPUB	1	
Forb	*Pterospora andromedea*	Woodland Pinedrops	N	PTEAND	5	
Forb	*Ranunculus acris*	Tall Buttercup	E	RANACR	*	-3
Forb	*Ranunculus californicus var. californicus*	California Buttercup	N	RANCALCAL	5	
Forb	*Ranunculus flammula*	Greater Creeping Spearwort	N	RANFLA	4	
Forb	*Ranunculus occidentalis var. occidentalis*	Western Buttercup	N	RANOCCOCC	4	
Forb	*Ranunculus repens var. repens*	Creeping Buttercup	E	RANREPREP	*	-3
Forb	*Ranunculus uncinatus var. parviflorus*	Idaho Buttercup	N	RANUNCPAR	4	
Forb	*Rorippa nasturtium-aquaticum*	Watercress	N	RORNAS	4	
Forb	*Rumex acetosella*	Common Sheep Sorrel	E	RUMACE	*	-2
Forb	*Rumex crispus*	Curly Dock	E	RUMCRI	*	-2
Forb	*Rumex maritimus*	Golden Dock	N	RUMMAR	5	
Forb	*Ruppia maritima*	Widgeongrass	N	RUPMAR	5	
Forb	*Sagina maxima ssp. crassicaulis*	Stickystem Pearlwort	N	SAGMAXCRA	3	
Forb	*Sagina procumbens*	Birdeye Pearlwort	E	SAGPRO	*	-2
Forb	*Salicornia virginica*	Virginia Glasswort	N	SALVIR	4	
Forb	*Sanicula crassicaulis var. crassicaulis*	Pacific Black snakeroot	N	SANCRACRA	3	
Forb	*Sanicula crassicaulis var. tripartita*	Pacific Black snakeroot	N	SANCRATRI	3	
Forb	*Scleranthus annuus*	German knotgrass	E	SCLANN	*	-2
Forb	*Sedum lanceolatum ssp. nesioticum*	Spearleaf Stonecrop	N	SEDLANNES	7	
Forb	*Sedum oreganum*	Oregon Stonecrop	N	SEDORE	5	
Forb	*Sedum spathulifolium*	Broadleaf Stonecrop	N	SEDSPA	5	
Forb	*Selaginella wallacei*	Wallace's Spikemoss	N	SELWAL	5	
Forb	*Senecio jacobaea*	Stinking Willie	E	SENJAC	*	-3
Forb	*Sherardia arvensis*	Blue Fieldmadder	E	SHEARV	*	-1
Forb	*Sisymbrium altissimum*	Tall Tumblemustard	E	SISALT	*	-3
Forb	*Sisyrinchium idahoense*	Idaho Blue-Eyed Grass	N	SISIDA	6	
Forb	*Solanum physalifolium*	Hoe Nightshade	E	SOLPHY	*	-1
Forb	*Solanum triflorum*	Cutleaf Nightshade	E	SOLTRI	*	-2

Growth Form	Scientific Name	Common Name	Origin	Species Code	Coefficient of Conservatism[1]	Weed Score[1]
Forb	*Solidago canadensis var. salebrosa*	Rough Canada Goldenrod	N	SOLCANSAL	3	
Forb	*Sonchus asper*	Spiny Sowthistle	E	SONASP	*	-1
Forb	*Sonchus oleraceus*	Common Sowthistle	E	SONOLE	*	-3
Forb	*Spergularia canadensis var. occidentalis*	Canadian Sandspurry	N	SPECANOCC	2	
Forb	*Spergularia macrotheca var. macrotheca*	Sticky Sandspurry	N	SPEMACMAC	4	
Forb	*Spergularia rubra*	Red Sandspurry	E	SPERUB	*	-1
Forb	*Spiranthes romanzoffiana*	Hooded Lady's Tresses	N	SPIROM	6	
Forb	*Stachys chamissonis var. cooleyae*	Coastal Hedgenettle	N	STACHACOO	4	
Forb	*Stellaria crispa*	Curled Starwort	N	STECRI	3	
Forb	*Stellaria media*	Common Chickweed	E	STEMED	*	-1
Forb	*Stellaria nitens*	shiny chickweed	N	STENIT	3	
Forb	*Symphyotrichum eatonii*	Eaton's Aster	N	SYMEAT	4	
Forb	*Symphyotrichum hallii*	Hall's Aster	N	SYMHAL	4	
Forb	*Taraxacum laevigatum*	Rock Dandelion	E	TARLAE	*	-2
Forb	*Taraxacum officinale*	Common Dandelion	E	TAROFF	*	-3
Forb	*Teesdalia nudicaulis*	Barestem Teesdalia	E	TEENUD	*	-1
Forb	*Tellima grandiflora*	Bigflower Tellima	N	TELGRA	3	
Forb	*Tiarella trifoliata var. trifoliata*	Threeleaf Foamflower	N	TIATRITRI	5	
Forb	*Tolmiea menziesii*	Youth On Age	N	TOLMEN	3	
Forb	*Tragopogon dubius*	Yellow Salsify	E	TRADUB	*	-2
Forb	*Trientalis borealis ssp. latifolia*	Broadleaf Starflower	N	TRIBORLAT	5	
Forb	*Trifolium dubium*	Suckling Clover	E	TRIDUB	*	-1
Forb	*Trifolium microcephalum*	Smallhead Clover	N	TRIMICROC	4	
Forb	*Trifolium microdon*	Thimble Clover	N	TRIMICROD	4	
Forb	*Trifolium olganthum*	Few-Flowered Clover	N	TRIOLG	4	
Forb	*Trifolium pratense*	Red Clover	E	TRIPRA	*	-2
Forb	*Trifolium repens*	White Clover	E	TRIREP	*	-3
Forb	*Trifolium subterraneum*	Subterranean Clover	E	TRISUB	*	-3
Forb	*Trifolium willdenowii*	Tomcat Clover	N	TRIWIL	5	
Forb	*Triphysaria pusilla*	Dwarf Owl's-Clover	N	TRIPUS	2	

Growth Form	Scientific Name	Common Name	Origin	Species Code	Coefficient of Conservatism[1]	Weed Score[1]
Forb	*Triteleia grandiflora ssp. howellii*	Howell's Triteleia	N	TRIGRAHOW	6	
Forb	*Triteleia hyacinthina*	White Brodiaea	N	TRIHYA	5	
Forb	*Urtica dioica ssp. gracilis*	California Nettle	N	URTDIOGRA	3	
Forb	*Verbascum thapsus*	Common Mullein	E	VERTHA	*	-2
Forb	*Veronica americana*	American Speedwell	N	VERAME	3	
Forb	*Veronica anagallis-aquatica*	Water Speedwell	E	VERANA	*	
Forb	*Veronica arvensis*	Corn Speedwell	E	VERARV	*	-2
Forb	*Veronica officinalis*	Common Gypsyweed	E	VEROFF	*	-2
Forb	*Veronica scutellata*	Skullcap Speedwell	N	VERSCU	4	
Forb	*Veronica serpyllifolia ssp. humifusa*	Brightblue Speedwell	N	VERSERHUM1	5	
Forb	*Vicia americana ssp. americana*	American Vetch	N	VICAMEAME	5	
Forb	*Vicia cracca*	Bird Vetch	E	VICCRA	*	-3
Forb	*Vicia hirsuta*	Tiny Vetch	E	VICHIR	*	-1
Forb	*Vicia nigricans ssp. gigantea*	Giant Vetch	N	VICNIGGIG	5	
Forb	*Vicia sativa ssp. sativa*	Garden Vetch	E	VICSATSAT	*	-1
Forb	*Vicia tetrasperma*	Lentil Vetch	E	VICTET	*	-1
Forb	*Vicia villosa*	Winter Vetch	E	VICVIL	*	-1
Forb	*Vinca major*	Bigleaf Periwinkle	E	VINMAJ	*	-2
Forb	*Viola adunca var. adunca*	Hookedspur Violet	N	VIOADUADU	4	
Forb	*Zigadenus venenosus var. venenosus*	Meadow Death camas	N	ZIGVENVEN	7	
Forb	*Zostera marina var. marina*	Seawrack	N	ZOSMARMAR	7	
Graminoid	*Achnatherum lemmonii var. lemmonii*	Lemmon's Needlegrass	N	ACHLEMLEM	6	
Graminoid	*Agrostis capillaris*	Colonial Bentgrass	E	AGRCAP	*	-3
Graminoid	*Agrostis exarata var. exarata*	Spike Bentgrass	N	AGREXAEXA	3	
Graminoid	*Agrostis stolonifera*	Creeping Bentgrass	E	AGRSTO	*	-3
Graminoid	*Aira caryophyllea*	Silver Hairgrass	E	AIRCAR	*	-1
Graminoid	*Aira praecox*	Yellow Hairgrass	E	AIRPRA	*	-1
Graminoid	*Alopecurus aequalis*	Shortawn Foxtail	N	ALOAEQ	3	
Graminoid	*Alopecurus pratensis*	Meadow Foxtail	E	ALOPRA	*	-2
Graminoid	*Anthoxanthum aristatum*	Annual Vernalgrass	E	ANTARI	*	-2

Growth Form	Scientific Name	Common Name	Origin	Species Code	Coefficient of Conservatism[1]	Weed Score[1]
Graminoid	*Anthoxanthum odoratum*	Sweet Vernalgrass	E	ANTODO	*	-2
Graminoid	*Arrhenatherum elatius*	Tall Oatgrass	E	ARRELA	*	-3
Graminoid	*Bromus carinatus*	California brome	N	BROCAR	4	
Graminoid	*Bromus commutatus*	hairy brome	E	BROCOM	*	-3
Graminoid	*Bromus diandrus*	Ripgut Brome	E	BRODIA	*	-3
Graminoid	*Bromus hordeaceus ssp. hordeaceus*	Soft Brome	E	BROHORHOR	*	-3
Graminoid	*Bromus inermis ssp. inermis*	Smooth Brome	E	BROINEINE	*	-3
Graminoid	*Bromus pacificus*	Pacific Brome	N	BROPAC	4	
Graminoid	*Bromus sitchensis var. sitchensis*	Sitka Brome	N	BROSITSIT	4	
Graminoid	*Bromus sterilis*	Poverty Brome	E	BROSTE	*	-3
Graminoid	*Bromus vulgaris*	Columbia Brome	N	BROVUL	3	
Graminoid	*Carex athrostachya*	slender beaked sedge	N	CARATH	5	
Graminoid	*Carex aurea*	Golden Sedge	N	CARAUR	4	
Graminoid	*Carex brevicaulis*	Shortstem Sedge	N	CARBREV	5	
Graminoid	*Carex deweyana*	Dewey Sedge	N	CARDEW	0	
Graminoid	*Carex inops ssp. inops*	Long-stolon Sedge	N	CARINOINO	4	
Graminoid	*Carex macrocephala*	Largehead Sedge	N	CARMAC	4	
Graminoid	*Carex obnupta*	Slough Sedge	N	CAROBN	3	
Graminoid	*Carex pachystachya*	Chamisso Sedge	N	CARPAC	2	
Graminoid	*Carex praticola*	meadow sedge	N	CARPRAT	4	
Graminoid	*Carex rossii*	Ross' Sedge	N	CARROSS	4	
Graminoid	*Carex tumulicola*	Splitawn Sedge	N	CARTUM	4	
Graminoid	*Cynosurus cristatus*	Crested Dogstail Grass	E	CYNCRI	*	-2
Graminoid	*Cynosurus echinatus*	Bristly Dogstail Grass	E	CYNECH	*	-2
Graminoid	*Dactylis glomerata*	Orchardgrass	E	DACGLO	*	-3
Graminoid	*Danthonia californica*	California Oatgrass	N	DANCAL	4	
Graminoid	*Deschampsia caespitosa*	Tufted Hairgrass	N	DESCAE	5	
Graminoid	*Deschampsia elongata*	Slender Hairgrass	N	DESELO	3	
Graminoid	*Distichlis spicata*	Saltgrass	N	DISSPI	4	
Graminoid	*Eleocharis palustris*	Common Spikerush	N	ELEPAL	4	

Growth Form	Scientific Name	Common Name	Origin	Species Code	Coefficient of Conservatism[1]	Weed Score[1]
Graminoid	*Elymus glaucus ssp. jepsonii*	Jepson's Blue Wildrye	N	ELYGLAJEP1	4	
Graminoid	*Elymus repens*	Quackgrass	E	ELYREP	*	-3
Graminoid	*Elymus trachycaulus ssp. trachycaulus*	Slender Wheatgrass	N	ELYTRATRA	6	
Graminoid	*Festuca occidentalis*	Western Fescue	N	FESOCC	5	
Graminoid	*Festuca roemeri*	Roemer's Fescue	N	FESROE	5	
Graminoid	*Festuca rubra ssp. rubra*	Red Fescue	N	FESRUBRUB	2	
Graminoid	*Festuca rubra var. mediana*	Coastal Red Fescue	N	FESRUBMED	4	
Graminoid	*Festuca subuliflora*	Crinkleawn Fescue	N	FESSUBULI	4	
Graminoid	*Glyceria borealis*	Small Floating Mannagrass	N	GLYBOR	5	
Graminoid	*Holcus lanatus*	Common Velvetgrass	E	HOLLAN	*	-3
Graminoid	*Hordeum brachyantherum*	Meadow Barley	N	HORBRA	3	
Graminoid	*Hordeum jubatum*	Foxtail Barley	N	HORJUB	2	
Graminoid	*Hordeum murinum*	Mouse Barley	E	HORMUR	*	-2
Graminoid	*Hordeum murinum ssp. leporinum*	Hare Barley	E	HORMURLEP	*	-2
Graminoid	*Juncus acuminatus*	Tapertip Rush	N	JUNACU	3	
Graminoid	*Juncus balticus var. balticus*	Mountain Rush	N	JUNBALBAL	4	
Graminoid	*Juncus bufonius*	Toad Rush	N	JUNBUF	1	
Graminoid	*Juncus effusus var. gracilis*	Lamp Rush	N	JUNEFFGRA	3	
Graminoid	*Juncus ensifolius*	Swordleaf Rush	N	JUNENS	2	
Graminoid	*Juncus tenuis*	Slender rush	N	JUNTEN	2	
Graminoid	*Koeleria macrantha*	Prairie June Grass	N	KOEMAC	6	
Graminoid	*Leymus mollis ssp. mollis*	American Dunegrass	N	LEYMOLMOL	4	
Graminoid	*Lolium perenne*	Perennial Ryegrass	E	LOLPER	*	-1
Graminoid	*Lolium perenne ssp. multiflorum*	Italian Ryegrass	E	LOLPERMUL	*	-1
Graminoid	*Luzula campestris*	Field Woodrush	E	LUZCAM	*	-2
Graminoid	*Luzula multiflora var. multiflora*	Common Woodrush	E	LUZMULMUL	*	-2
Graminoid	*Melica smithii*	Smith's melic grass	N	MELSMI	6	
Graminoid	*Melica subulata var. subulata*	Alaska Oniongrass	N	MELSUBSUB	4	
Graminoid	*Phalaris arundinacea*	Reed Canarygrass	E	PHAARU	*	-3
Graminoid	*Phleum pratense*	Timothy	E	PHLPRA	*	-2

Growth Form	Scientific Name	Common Name	Origin	Species Code	Coefficient of Conservatism[1]	Weed Score[1]
Graminoid	*Poa annua*	Annual Bluegrass	E	POAANN	*	-3
Graminoid	*Poa bulbosa*	Bulbous Bluegrass	E	POABUL	*	-3
Graminoid	*Poa compressa*	Canada Bluegrass	E	POACOM	*	-3
Graminoid	*Poa confinis*	Coastline Bluegrass	N	POACON	0	
Graminoid	*Poa pratensis*	Kentucky Bluegrass	E	POAPRA	*	-3
Graminoid	*Poa trivialis*	Rough Bluegrass	E	POATRI	*	-1
Graminoid	*Polypogon monspeliensis*	Annual Rabbitsfoot Grass	E	POLMON	*	-1
Graminoid	*Puccinellia nuttalliana*	Nuttall's Alkaligrass	N	PUCNUTT	6	
Graminoid	*Schedonorus arundinaceum*	Tall Fescue	E	SCHARU	*	-2
Graminoid	*Schedonorus pratensis*	Meadow ryegrass	E	SCHPRA	*	-2
Graminoid	*Schoenoplectus acutus var. acutus*	Hardstem Bulrush	N	SCHACUACU	4	
Graminoid	*Schoenoplectus americanus*	Chairmaker's Bulrush	N	SCHAME	5	
Graminoid	*Triglochin maritima*	Seaside Arrowgrass	N	TRIMAR	6	
Graminoid	*Vulpia bromoides*	Brome Fescue	E	VULBRO	*	-1
Graminoid	*Vulpia myuros*	Rat-Tail Fescue	E	VULMYU	*	-1
Shrub	*Amelanchier alnifolia var. alnifolia*	Saskatoon Serviceberry	N	AMEALNALN	4	
Shrub	*Cotoneaster horizontalis*	Rockspray Cotoneaster	E	COTHOR	*	-2
Shrub	*Gaultheria shallon*	Salal	N	GAUSHA	4	
Shrub	*Holodiscus discolor*	Oceanspray	N	HOLDIS	3	
Shrub	*Lonicera involucrata var. involucrata*	Twinberry Honeysuckle	N	LONINVINV	4	
Shrub	*Mahonia aquifolium*	Hollyleaved Barberry	N	MAHAQU	3	
Shrub	*Mahonia nervosa*	Cascade Barberry	N	MAHNER	5	
Shrub	*Marrubium vulgare*	Horehound	E	MARVUL	*	-3
Shrub	*Philadelphus lewisii*	Lewis' Mock Orange	N	PHILEW	5	
Shrub	*Ribes divaricatum*	Spreading Gooseberry	N	RIBDIV	4	
Shrub	*Ribes lacustre*	Prickly Currant	N	RIBLAC	5	
Shrub	*Ribes sanguineum*	Redflower Currant	N	RIBSAN	4	
Shrub	*Rosa gymnocarpa*	Dwarf Rose	N	ROSGYM	4	
Shrub	*Rosa nutkana var. nutkana*	Nootka Rose	N	ROSNUTNUT	3	
Shrub	*Rubus discolor*	Himalayan Blackberry	E	RUBDIS	*	-3

Growth Form	Scientific Name	Common Name	Origin	Species Code	Coefficient of Conservatism[1]	Weed Score[1]
Shrub	*Rubus laciniatus*	Cutleaf Blackberry	E	RUBLAC	*	-3
Shrub	*Rubus leucodermis*	Whitebark Raspberry	N	RUBLEU	3	
Shrub	*Rubus parviflorus*	Thimbleberry	N	RUBPAR	3	
Shrub	*Rubus spectabilis*	Salmonberry	N	RUBSPE	3	
Shrub	*Rubus ursinus ssp. macropetalus*	California Blackberry	N	RUBURSMAC	1	
Shrub	*Salix hookeriana*	Dune Willow	N	SALHOO	4	
Shrub	*Salix lucida ssp. lasiandra*	Pacific Willow	N	SALLUCLAS	3	
Shrub	*Salix scouleriana*	Scouler's Willow	N	SALSCO	3	
Shrub	*Sambucus racemosa*	Red Elderberry	N	SAMRAC	4	
Shrub	*Shepherdia canadensis*	Russet Buffaloberry	N	SHECAN	5	
Shrub	*Spiraea douglasii*	Rose Spirea	N	SPIDOU	3	
Shrub	*Symphoricarpos albus var. laevigatus*	Common Snowberry	N	SYMALBLAE	3	
Shrub	*Vaccinium ovatum*	California Huckleberry	N	VACOVAT	4	
Tree	*Abies grandis*	Grand Fir	N	ABIGRA	3	
Tree	*Acer glabrum var. douglasii*	Douglas Maple	N	ACEGLADOU	4	
Tree	*Acer macrophyllum*	Bigleaf Maple	N	ACEMAC	3	
Tree	*Alnus rubra*	Red Alder	N	ALNRUB	1	
Tree	*Arbutus menziesii*	Pacific Madrone	N	ARBMEN	3	
Tree	*Cornus sericea ssp. occidentalis*	Western Dogwood	N	CORSEROCC	4	
Tree	*Crataegus douglasii*	Black Hawthorn	N	CRADOU	3	
Tree	*Crataegus monogyna*	Oneseed Hawthorn	E	CRAMON	*	-3
Tree	*Crataegus suksdorfii*	Suksdorf's Hawthorn	N	CRASUK	4	
Tree	*Frangula purshiana*	Cascara Buckthorn	N	FRAPUR	3	
Tree	*Ilex aquifolium*	English Holly	E	ILEAQU	*	-2
Tree	*Ilex opaca*	American Holly	E	ILEOPA	*	-2
Tree	*Juniperus scopulorum*	Rocky Mountain Juniper	N	JUNSCO	4	
Tree	*Laburnum anagyroides*	Golden Chain Tree	E	LABANA	*	-3
Tree	*Malus fusca*	Oregon Crab Apple	N	MALFUS	3	
Tree	*Malus sylvestris*	European Crab Apple	E	MALUSYL	*	-1
Tree	*Oemleria cerasiformis*	Indian Plum	N	OEMCER	3	

Growth Form	Scientific Name	Common Name	Origin	Species Code	Coefficient of Conservatism[1]	Weed Score[1]
Tree	*Picea sitchensis*	Sitka Spruce	N	PICSIT	4	
Tree	*Pinus contorta var. latifolia*	Lodgepole Pine	N	PINCONLAT	3	
Tree	*Populus balsamifera ssp. trichocarpa*	Black Cottonwood	N	POPBALTRI	2	
Tree	*Populus tremuloides*	Quaking Aspen	N	POPTRE	4	
Tree	*Prunus avium*	Sweet Cherry	E	PRUAVI	*	-1
Tree	*Prunus emarginata*	Bitter Cherry	N	PRUEMA	3	
Tree	*Pseudotsuga menziesii var. menziesii*	Douglas-Fir	N	PSEMENMEN	2	
Tree	*Pyrus communis*	Common Pear	E	PYRCOM	*	-1
Tree	*Quercus garryanavar. garryana*	Oregon White Oak	N	QUEGARGAR	4	
Tree	*Sorbus aucuparia*	European Mountain Ash	E	SORAUC	*	-1
Tree	*Taxus brevifolia*	Pacific Yew	N	TAXBRE	5	
Tree	*Thuja plicata*	Western Redcedar	N	THUPLI	3	
Tree	*Tsuga heterophylla*	Western Hemlock	N	TSUHET	4	
Tree	*Ulmus alata*	Winged Elm	E	ULMALA	*	-2

[1] Coefficient of Conservatism value and Weed Scores are draft scores that are still under development. An * in the Coefficient of Conservatism column indicates a non-native species that will be calculated using a 0 “C” value when exotic species are used in calculations of floristic indices.

Appendix C. Yearly Project Task List

This table identifies each task by project stage, indicates who is responsible, and establishes the timing for its execution. Protocol sections and SOPs are referenced as appropriate.

Project Stage	Task Description	Responsibility	Timing
Preparation (*Sections 3A, 3B and 4B*)	Initiate announcement for seasonal field crew positions	Project Lead	Dec
	Plan schedule and logistics, identify needed equipment and supplies	Project Lead	By Jan 15
	Ensure all project compliance needs are completed for the coming season	Park Resource Chief	Jan-Feb
	Inform GIS Specialist and Data Manager of specific needs for upcoming field season	Project Lead	By Mar 1
	Hire seasonal field crew positions	Park Resource Chief and Project Lead	By Mar 15
	Purchase equipment and supplies	Project Lead	By Apr 15
	Ensure that project workspace is ready for use (SOP 1)	Project Lead and Data Manager	By Apr 15
	Update and deploy database application for data entry	Data Manager	By May 1
	Update and load data dictionary, background maps, and target coordinates into GPS units. Make sure GPS download software is available to field crews.	GIS Specialist	By May 1
	Prepare and print field maps	GIS Specialist	By May 1
	Generate field visit reports from database	Project Lead	By May 1
	Initiate computer access and key requests	Park Resource Chief and Project Lead	May
	Provide field crew email addresses and user logins to Data Manager. Grant modify access to project workspace once crew user logins are known.	Project Lead	May
	Provide database/GPS training as needed	Data Manager and GIS Specialist	May
	Train field crew in species identification, use of equipment, field sampling protocols, and safety	Project Lead	May
Data Acquisition (*Section 3C*)	Collect field data during field trips. Review data forms for completeness and accuracy after each field day.	Technicians	May-Jun
	Review field forms for completeness and accuracy	Field Crew Lead	Daily
	De-brief crew on operations, field methods, gear needs	Project Lead and Park Resource Chief	Weekly
Data Entry & Processing (*Section 4C and 4D*)	Download GPS data and provide files to GIS Specialist for correction (SOP 5)	Technicians	Weekly
	Download and process digital images	Technicians	Weekly
	Enter data into the database (SOP 10)	Technicians	Weekly
	Verify accurate transcription from field forms to database as data are entered (SOP 10)	Technicians	Weekly

Project Stage	Task Description	Responsibility	Timing
	Correct GPS data and relate any problems to Field Crew Lead and Project Lead	GIS Specialist	Weekly
	Review GPS location data and database entries for completeness and accuracy	Field Crew Lead and/or Project Lead	Biweekly
	Scan all field forms and file in the project workspace	Field Crew Lead	By Jul 15
	Confirm that data entry and data verification is complete, and notify the Project Lead and Data Manager	Field Crew Lead	By Jul 15
	Complete field season report, send to Project Lead, Park Resource Chief, Data Manager, and GIS Specialist; submit to the NCCN Digital Library [1] when finalized (SOP 13)	Field Crew Lead	By Jul 15
	Merge, correct, and export GPS data. Upload processed and verified coordinates to database.	GIS Specialist	Jul-Aug
Quality Review (*Section 4E*)	Complete data quality review and data validation using database tools (SOP 12)	Project Lead	Sep-Nov
	Determine best coordinates for subsequent mapping and field work	Project Lead and GIS Specialist	Oct-Nov
Metadata (*Section 4F and 4J*)	Identify any sensitive information contained in the data set (SOP 14)	Project Lead	By Nov 30
	Update project metadata interview form	Project Lead	By Nov 30
Data Certification & Delivery (*Section 4G*)	Certify the season's data and complete the certification report (SOP 12)	Project Lead	Nov
	Deliver certification report, certified data, and updated metadata to Data Manager (SOP 13)	Project Lead	By Nov 30
	Store certified data files in the project workspace	Data Manager	Dec-Jan
	Update project GIS data sets, layers and associated metadata records	GIS Specialist	Dec-Jan
	Finalize and parse metadata records, store in the project workspace	Data Manager and GIS Specialist	By Mar 15
Data Analysis (*Section 4H*)	Explore data in summary queries using database tools	Project Lead	Feb-Mar
	Perform *ad hoc* queries as needed	Project Lead and Data Manager	Feb-Mar
	Interpret results of automated and *ad hoc* queries	Project Lead	Feb-Mar
Reporting & Product Development (*Section 4I*)	Export automated summary results and reports from database	Project Lead	Feb-Mar
	Generate report-quality map output for reports	GIS Specialist	Feb-Mar
	Acquire the proper report template from the NPS website (http://www.nature.nps.gov/publications/NRPM/index.cfm), draft annual report	Project Lead	Feb-Mar
	Screen all reports and data products for sensitive information (SOP 14)	Project Lead and Park Resource Chief	Feb-Mar

Project Stage	Task Description	Responsibility	Timing
	Prepare draft report and distribute to Park Resource Chief and Network Plant Ecologists for preliminary review	Project Lead	By Mar 15
Product Delivery (*Section 4K*)	Submit draft I&M report to Network Program Manager for review	Project Lead	By Mar 31
	Review report for formatting and completeness, notify Project Lead of approval or need for changes	Network Program Manager	April
	Upload completed report to NCCN Digital Library [1], notify Data Manager (SOP 13)	Project Lead	Upon approval
	Deliver other products according to the delivery schedule and instructions (SOP 13)	Project Lead	Upon completion
	Product check-in	Data Manager	Upon receipt
Posting & Distribution (*Section 4K*)	Submit metadata to the NPS Data Store [2]	Data Manager	By Mar 15
	Create an online reference record and post reports to the NPS Data Store [2]	Data Manager	Upon receipt
	Update NPSpecies [3] records according to data observations	Data Manager	Dec-Mar
	Submit certified data and GIS data sets to the NPS Data Store [2]	Data Manager	Jun (after 2-year hold)
Archiving & Records Management (*Section 4L*)	Store finished products slated for permanent retention in NCCN Digital Library [1]	Data Manager	Upon receipt
	Review, clean up and store and/or dispose of project files according to NPS Director's Order 19 [4] (SOP 1)	Project Lead	Jan
	Move hard-copy data forms and voucher specimens to park collections after making sure that all forms have been scanned and all species records are entered into NPSpecies [3]	Project Lead	Jan
Season Close-out (*Section 3D and 4M*)	Inventory equipment and supplies	Field Crew Lead	By Jul 15
	De-brief field crew concerning safety, logistics, and data concerns	Project Lead, Technicians	By Jul 15
	Meet to discuss the recent field season, and document any needed changes to field sampling protocols or the database	Project Lead, Park Resource Chief, Network Plant Ecologists, Data Manager, and GIS Specialist	By Nov 30 of the same year
	Discuss and document needed changes to analysis and reporting procedures and plan for the coming field season	Project Lead, Park Resource Chief, Network Plant Ecologists, Data Manager, and GIS Specialist	By Apr 15

[1] The NCCN Digital Library is a document management system implemented in Microsoft SharePoint for maintaining important digital files (reports, protocol documents, and seleted project images) within a content management system, and to make them available to NCCN and NPS users.

[2] The NPS Data Store is an internet clearinghouse for documents, data and metadata on natural and cultural resources in parks. It is a primary component of the NPS Integrated Resource Management Applications (IRMA) portal (http://irma.nps.gov).

[3] NPSpecies is the NPS database and application for maintaining park-specific species lists and observation data, and is also a component of the IRMA portal (http://irma.nps.gov).

[4] NPS Director's Order 19 provides a schedule indicating the amount of time that the various kinds of records should be retained. Available at: http://home.nps.gov/applications/npspolicy/DOrders.cfm

Appendix D. Prairie Vegetation Monitoring Protocol Database Documentation

The database for this project consists of three types of tables: core tables describing the "who, where and when" of data collection, project-specific tables, and lookup tables that contain domain constraints for other tables. Although core tables are based on NCCN standards, they may contain fields, domains or descriptions that have been added or altered to meet project objectives.

The database includes the following standard tables:

tbl_Locations	Sample locations - places where data collection occurs
tbl_Schedule	Schedule for monitoring locations
tbl_Target_Coords	Target coordinates for sample locations selected within GIS
tbl_Analysis_Notes	Sample location-specific comments related to data analysis
tbl_Events	Data collection event for a given location
tbl_Coordinates	Coordinate data collected during sampling events
tbl_GPS_Info	GPS information associated with sampling event coordinates
tbl_Observers	Observers for each sampling event
tbl_QA_Results	Quality assurance query results for the working data set
tbl_Edit_Log	Edit log for changes made to data after certification
tbl_Task_List	Checklist of tasks to be completed at sampling locations
tbl_Images	Images associated with sampling events

The following are project-specific data tables:

tbl_Phenology	Phenological stage of key taxa observed along transects
tbl_Quadrat_Events	Sampling event information specific to a quadrat
tbl_Quadrat_Obs	Quadrat species observation data
tbl_Transect_Obs	Transect segment observation data

The following are a few of the more prominent, standard lookup tables:

tlu_Project_Crew	List of personnel associated with a project
tlu_Project_Taxa	List of species associated with project observations
tlu_Park_Taxa	Park-specific attributes for taxa

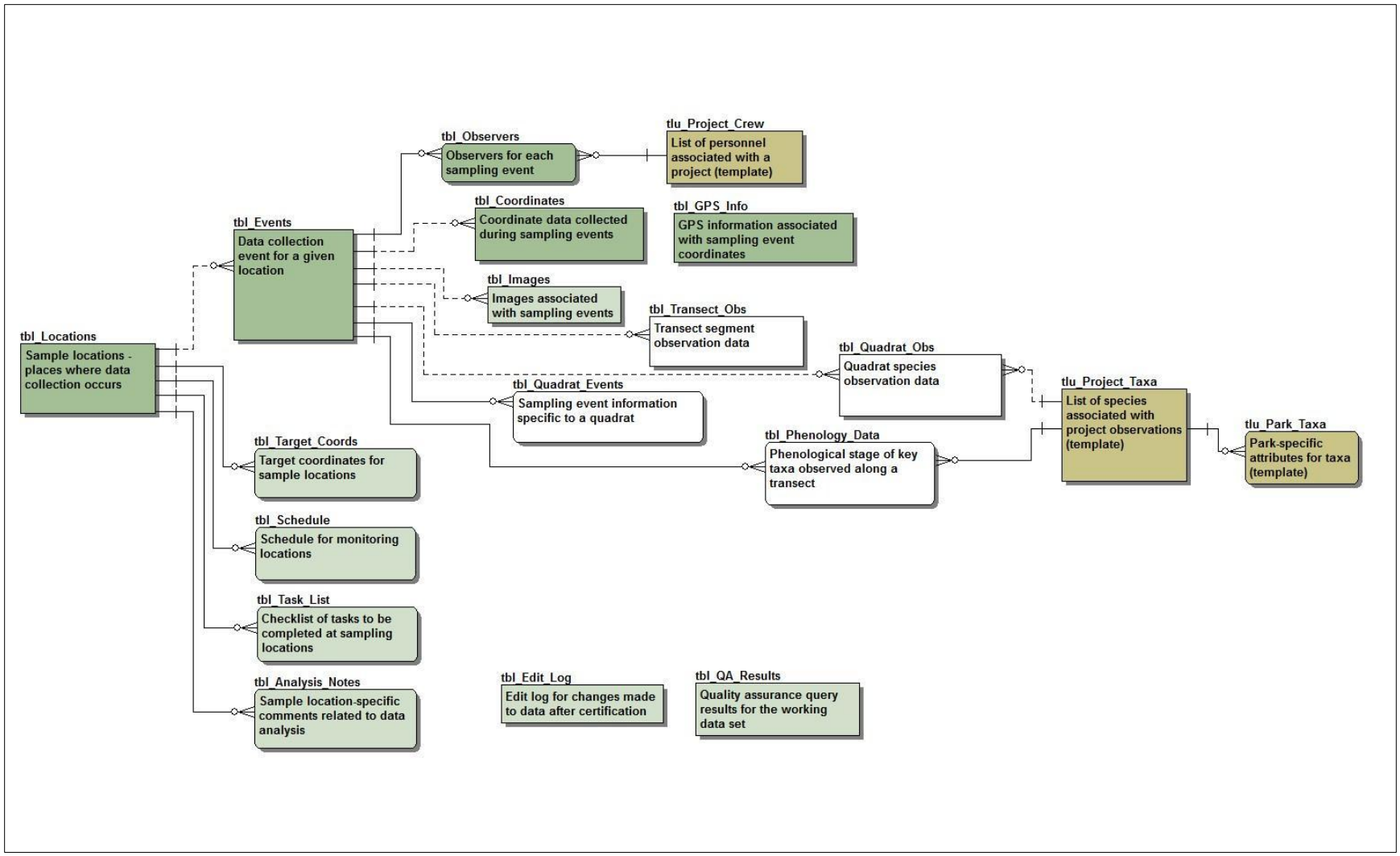


Figure D.1. Entity relationship diagram for the project database. Relationships between tables are represented by lines. Dark green tables represent core standard tables; light green represents extended standard tables; light brown are standard lookup tables. Project-specific tables are unshaded.

Data Dictionary

Required fields are denoted with an asterisk (*).
File name: Prairie_Veg_VCa03.dm1
Platform: Microsoft Access
Report date: 6/14/2010 9:04:53 AM

tbl_Analysis_Notes - Sample location-specific comments related to data analysis

Index	*Index columns*
Location_ID	Location_ID
pk_tbl_Analysis_Notes (primary)	Location_ID, Analysis_year

Field name	*Index/key*	*Data type*	*Description*
Location_ID	primary (FK)*	text (50)	Sampling location
Analysis_year	primary *	text (4)	Analysis year (e.g., 2010)
Analysis_notes		memo	Comments about this sample location related to the specified analysis year

tbl_Coordinates - Coordinate data collected during sampling events

Index	*Index columns*
Coord_label	Coord_label
Coord_type	Coord_type
Coord_updated	Coord_updated
Datum	Datum
Event_ID (unique)	Event_ID
Field_coord_source	Field_coord_source
pk_tbl_Coordinates (primary)	Coord_ID

Field name	*Index/key*	*Data type*	*Description*
Coord_ID	primary *	text (50)	Unique identifier for each coordinate record
	Default: =Format(Now(),"yyyymmddhhnnss") & '-' & 1000000000*Rnd(Now())		
Event_ID	unique (FK)*	text (50)	Sampling event of coordinate data collection
Is_best		bit	Indicates whether this set of coordinates is the best available for this location
UTM_east		double	Final UTM easting (zone 10N, meters), including any offsets and corrections
UTM_north		double	Final UTM northing (zone 10N, meters), including any offsets and corrections
Coord_type	indexed	text (20)	Coordinate type stored in UTM_east and UTM_north: target, field, post-processed
Datum	indexed	text (5)	Datum of UTM_east and UTM_north
	Default: "NAD83"		
Est_horiz_error		double	Estimated horizontal error (meters) of UTM_east and UTM_north
Elevation_m		single	Elevation in meters, derived from GIS using final UTMs
Slope_deg		single	Slope steepness in degrees, derived from GIS using final UTMs
Aspect_deg		single	Slope aspect in degrees, derived from GIS using final UTMs
Coord_label	indexed	text (25)	Name of the coordinate feature (e.g., plot center, NW corner)
Field_UTME		double	UTM easting (zone 10N) as recorded in the field
Field_UTMN		double	UTM northing (zone 10N) as recorded in the field
Field_datum		text (5)	Datum of field coordinates

Field_horiz_error		double	Field coordinate horizontal error (m)
Field_offset_m		double	Distance (meters) from the field coordinates to the target
	Constraint: Is Null Or >=0		
Field_offset_azimuth		smallint	Azimuth (degrees, declination corrected) from the coordinates to the target
	Constraint: Is Null Or (>=0 And <=360)		
Field_coord_source	indexed	text (12)	Field coordinate data source
GPS_file_name		text (50)	GPS rover file used for data downloads
GPS_model		text (25)	Make and model of GPS unit used to collect field coordinates
Source_citation		text (250)	Name, date and scale of the source map
Coordinate_notes		memo	Notes about this set of coordinates
Coord_created_date		datetime	Time stamp for record creation
	Default: Now()		
Coord_updated	indexed	datetime	Date of the last update to this record
Coord_updated_by		text (50)	Person who made the most recent edits

tbl_Edit_Log - Edit log for changes made to data after certification

Index	*Index columns*
Edit_date	Edit_date
Edit_type	Edit_type
pk_tbl_Edit_Log (primary)	Data_edit_ID
Project_code	Project_code
Table_affected	Table_affected
User_name	User_name

Field name	*Index/key*	*Data type*	*Description*
Data_edit_ID	primary *	text (50)	Unique identifier for each data edit record
	Default: =Format(Now(),"yyyymmddhhnnss") & '-' & 1000000000*Rnd(Now())		
Project_code	indexed *	text (10)	Project code, for linking information with other data sets and applications
Edit_date	indexed *	datetime	Date on which the edits took place
	Default: Now()		
Edit_type	indexed *	text (12)	Type of edits made: deletion, update, append, reformat, tbl design
Edit_reason	*	text (100)	Brief description of the reason for edits
User_name	indexed *	text (50)	Name of the person making data edits
Table_affected	indexed	text (50)	Table affected by edits
Fields_affected		text (200)	Description of the fields affected
Records_affected		text (200)	Description of the records affected
Data_edit_notes		memo	Comments about the data edits

tbl_Events - Data collection event for a given location

Index	*Index columns*
udx_tbl_Events (unique)	Location_ID, Start_date
Updated_date	Updated_date
Verified_date	Verified_date
Certified_date	Certified_date
Entered_date	Entered_date
Location_ID	Location_ID
pk_tbl_Events (primary)	Event_ID
Start_date	Start_date

Field name	*Index/key*	*Data type*	*Description*
Event_ID	primary *	text (50)	Unique identifier for each sampling event
	Default: =Format(Now(),"yyyymmddhhnnss") & '-' & 1000000000*Rnd(Now())		
Location_ID	unique (FK)*	text (50)	Sampling location for this event
Project_code	*	text (10)	Project code, for linking information with other data sets and applications
	Default: "VCa03"		
Start_date	unique *	datetime	Start date of the sampling event
Start_time		datetime	Start time of the sampling event
End_date		datetime	End date of the sampling event (optional)
End_time		datetime	End time of the sampling event (optional)
Hours_spent		single	Amount of hours spent setting up and collecting data
	Constraint: Is Null Or (>=0 And <=40)		
N_quadrats		tinyint	Number of quadrats sampled during the event
Declination		text (25)	Declination correction factor for measurement of compass bearings
Transect_easting		int	Transect easting value derived in the field
Transect_northing		int	Transect northing value derived in the field
GPS_file_name		text (50)	GPS rover file used for data downloads
Transect_notes		memo	Sampling event comments specific to transect sampling
Quadrat_notes		memo	Sampling event comments specific to quadrat sampling
Event_notes		memo	Comments about the sampling event
Entered_by		text (50)	Person who entered the data for this event
Entered_date	indexed	datetime	Date on which data entry occurred
	Default: Now()		
Updated_by		text (50)	Person who made the most recent updates
Updated_date	indexed	datetime	Date of the most recent edits
Verified_by		text (50)	Person who verified accurate data transcription
Verified_date	indexed	datetime	Date on which data were verified
Certified_by		text (50)	Person who certified data for accuracy and completeness
Certified_date	indexed	datetime	Date on which data were certified
Is_excluded		bit	Flag to exclude the sampling event from data summary output
	Default: False		
QA_notes		memo	Quality assurance comments for the selected sampling event

tbl_GPS_Info - GPS information associated with sampling event coordinates

Index	*Index columns*
Coord_ID	Coord_ID
Corr_type	Corr_type
Datum	GPS_datum
Feat_name	Feat_name
Feat_type	Feat_type
GPS_date	GPS_date
GPS_file	GPS_file
Location_ID	Location_ID
pk_tbl_GPS_Info (primary)	GPS_ID

Field name	*Index/key*	*Data type*	*Description*
GPS_ID	primary *	text (50)	Unique identifier for the GPS record
	Default: =Format(Now(),"yyyymmddhhnnss") & '-' & 1000000000*Rnd(Now())		
Coord_ID	indexed	text (50)	Coordinate identifier
Location_ID	indexed	text (50)	Sample location, used for temporary links
Feat_name	indexed	text (50)	Feature name in data dictionary
Flag	*	bit	Internal flag used to identify records while matching with tbl_Coordinates during post-season processing
	Default: False		
GPS_file	indexed	text (50)	GPS file name
GPS_date	indexed	datetime	Date GPS file was collected
GPS_time		datetime	Time GPS file was collected
Corr_type	indexed	text (50)	GPS file correction type
GPS_UTME		double	UTM easting in GPS unit
GPS_UTMN		double	UTM northing in GPS unit
UTM_zone		text (5)	UTM projection system zone
	Default: "10N"		
GPS_datum	indexed	text (5)	Datum of GPS coordinates
Feat_type	indexed	text (20)	Feature type (point, line, or polygon) collected with GPS
Data_dict_name		text (50)	Data dictionary name used to collect feature
Elev_m		double	Elevation (meters) in GPS unit
Num_sat		smallint	Number of satellites tracked by GPS unit during data collection
GPS_duration		text (25)	Length of time GPS file was open
Filt_pos		smallint	Number of GPS positions exported from GPS file
PDOP		double	Position dilution of precision scale
HDOP		double	Horizontal dilution of precision scale
H_err_m		double	Horizontal error (meters)
V_err_m		double	Vertical error (meters)
Std_dev_m		double	Standard deviation (meters)
GPS_process_notes		text (255)	GPS file processing notes
Is_better	*	bit	Indicates that the field crew thought this coordinate record to be an improvement over the current Is_best coordinate
	Default: False		

tbl_Images - Images associated with sampling events

Index	*Index columns*
Event_ID	Event_ID
Image_label	Image_label
Image_quality	Image_quality
Image_type	Image_type
pk_tbl_Images (primary)	Image_ID
Sort_order	Sort_order

Field name	*Index/key*	*Data type*	*Description*
Image_ID	primary *	text (50)	Unique identifier for each image record
	Default: =Format(Now(),"yyyymmddhhnnss") & '-' & 1000000000*Rnd(Now())		
Event_ID	indexed (FK)*	text (50)	Sampling event
Image_type	indexed	text (20)	Type of image
	Default: "Ground photo"		
Image_label	indexed	text (25)	Image caption or label
Image_desc		text (255)	Brief description of the image bearing, perspective, etc.
Frame_number		text (10)	Frame number for photographic images
Image_date		datetime	Date on which the image was created, if different from the sampling event date
Image_source		text (50)	Name of the person or organization that created the image
Image_quality	indexed	tinyint	Quality of the image
Is_edited_version		bit	Indicates whether this version of the image is the edited (originals = False)
Object_format		text (20)	Format of the image
Orig_format		text (20)	Format of the original image
Image_edit_notes		text (200)	Comments about the editing or processing performed on the image
Image_is_active		bit	Indicates whether the image is still being used for navigation or interpretation
	Default: True		
Image_root_path		text (100)	Drive space location of the main project folder or image library
Image_project_path		text (100)	Location of the image from the main project folder or image library
	Default: "Images\"		
Image_filename		text (100)	Name of the image including extension (.jpg) but without the image path
Image_notes		memo	Comments about the image
Sort_order	indexed *	int	Sort order for displaying records in the order they were entered

tbl_Locations - Sample locations - places where data collection occurs

Index	*Index columns*
Firing_order	Firing_order
Loc_updated	Loc_updated
Location_code	Location_code
Location_status	Location_status
Location_type	Location_type
Panel_name	Panel_name
Panel_type	Panel_type
Park_code	Park_code
pk_tbl_Locations (primary)	Location_ID
Public_offset	Public_offset
udx_tbl_Locations (unique)	Location_code

Field name	*Index/key*	*Data type*	*Description*
Location_ID	primary *	text (50)	Unique identifier for each sample location
	Default: =Format(Now(),"yyyymmddhhnnss") & '-' & 1000000000*Rnd(Now())		
Park_code	indexed *	text (4)	Park in which the site is located
Location_code	unique *	text (10)	Alphanumeric code for the sample location
Location_type	indexed *	text (20)	Indicates the type of sample location
Location_status	indexed *	text (10)	Status of the sample location
	Default: "Active"		
Location_name		text (50)	Brief colloquial name of the sample location (optional)
Panel_name	indexed *	text (10)	Name of the sampling panel, used to group data for analysis
Panel_type	indexed	text (20)	Sampling panel for the site
Firing_order	indexed	int	Site selection and evaluation order
UTME_public		double	UTM easting (zone 10N, meters). Note: in addition to any measurement error, these coordinates may have been offset up to 2 km from their actual position.
UTMN_public		double	UTM northing (zone 10N, meters). Note: in addition to any measurement error, these coordinates may have been offset up to 2 km from their actual position.
Public_offset	indexed	text (50)	Type of processing performed to make coordinates publishable
Travel_notes		memo	Directions for relocating the sample location
Location_desc		memo	Environmental description of the sampling location
Location_notes		memo	Other notes about the sample location
Loc_established		datetime	Date the sample location was established
Loc_discontinued		datetime	Date the sample location was discontinued
Loc_created_date		datetime	Time stamp for record creation
	Default: Now()		
Loc_updated	indexed	datetime	Date of the last update to this record
Loc_updated_by		text (50)	Person who made the most recent edits

tbl_Observers - Observers for each sampling event

Index	*Index columns*
Contact_ID	Contact_ID
Event_ID	Event_ID
Observer_role	Observer_role
pk_tbl_Observers (primary)	Event_ID, Contact_ID, Observer_role

Field name	*Index/key*	*Data type*	*Description*
Event_ID	primary (FK)*	text (50)	Sampling event identifier
Contact_ID	primary (FK)*	text (50)	Observer identifier
Observer_role	primary *	text (25)	Role of the observer during data collection (optional)

Observer_notes	text (200)	Comments about the observer specific to this sampling event

tbl_Phenology - Phenological stage of key taxa observed along a transect

Index	*Index columns*
Event_ID	Event_ID
pk_tbl_Phenology (primary)	Event_ID, Taxon_ID, Stage
Stage	Stage
Taxon_ID	Taxon_ID

Field name	*Index/key*	*Data type*	*Description*
Event_ID	primary (FK)*	text (50)	Sampling event
Taxon_ID	primary *	text (50)	Taxon observed
Stage	primary *	text (25)	Phenological stage observed
Phenology_notes		text (50)	Comments about the phenology stage observation

tbl_QA_Results - Quality assurance query results for the working data set

Index	*Index columns*
Data_scope	Data_scope
pk_tbl_QA_Results (primary)	Query_name, Time_frame, Data_scope
Query_name	Query_name
Query_result	Query_result
Query_type	Query_type
Time_frame	Time_frame

Field name	*Index/key*	*Data type*	*Description*
Query_name	primary *	text (100)	Name of the quality assurance query
Data_scope	primary *	tinyint	Scope of the data included in queries: 0=Uncertified events only, 1=Both certified and uncertified, 2=Certified events only
Time_frame	primary *	text (30)	Field season year or range of dates for the data being passed through quality assurance checks
Query_type	indexed	text (20)	Severity of data errors being trapped: 1=Critical, 2=Warning, 3=Information
Query_result	indexed	text (50)	Query result as the number of records returned the last time the query was run
Query_run_time		datetime	Run time of the query results
Query_description		memo	Description of the query
Query_expression		memo	Evaluation expression built into the query
Remedy_desc		memo	Details about actions taken and/or not taken to resolve errors
Remedy_date		datetime	When the remedy description was last edited
QA_user		text (50)	Name of the person doing quality assurance
Is_done	*	bit	Temporary flag to indicate that the user is done reviewing this query even if some records remain

tbl_Quadrat_Events - Sampling event information specific to a quadrat

Index	*Index columns*
pk_tbl_Quadrat_Events (primary)	Event_ID, Quadrat_num
Event_ID	Event_ID
Quadrat_num	Quadrat_num
Stratum	Stratum

Field name	*Index/key*	*Data type*	*Description*
Event_ID	primary (FK)*	text (50)	Sampling event
Quadrat_num	primary *	tinyint	Quadrat number
Stratum	indexed *	text (1)	Vegetation stratum: E (exotic) or N (native)

UTME	double	UTM easting for the quadrat (zone 10N, meters)
UTMN	double	UTM northing for the quadrat (zone 10N, meters)
Vasc_cover	tinyint	Total estimated cover of vascular plants
Nonvasc_cover	tinyint	Total estimated cover of nonvascular plants
Unvegetated	tinyint	Total estimated percent of quadrat that is unvegetated
Quadrat_notes	text (100)	Comments specific to this quadrat

tbl_Quadrat_Obs - Quadrat species observation data

Index	*Index columns*
Event_ID	Event_ID
pk_tbl_Quadrat_Obs (primary)	Obs_ID
Taxon_ID	Taxon_ID
udx_tbl_Quadrat_Obs	Event_ID, Quadrat_numb, Taxon_ID

Field name	*Index/key*	*Data type*	*Description*
Obs_ID	primary *	int	Unique identifier for each observation record (also the sort order for data entry)
Event_ID	indexed (FK)*	text (50)	Sampling event
Quadrat_num	indexed *	tinyint	Quadrat number
Taxon_ID	indexed *	text (50)	Taxon observed
Cover_class		tinyint	Cover class category
Obs_notes		text (50)	Comments about this observation

tbl_Schedule - Schedule for monitoring locations

Index	*Index columns*
Calendar_year	Calendar_year
Location_ID	Location_ID
pk_tbl_Schedule (primary)	Calendar_year, Location_ID

Field name	*Index/key*	*Data type*	*Description*
Calendar_year	primary *	text (10)	Calendar year for scheduled sampling (not necessarily actually sampled)
Location_ID	primary (FK)*	text (50)	Monitoring location
Schedule_notes		text (255)	Comments about this schedule item (especially for out-of-rotation sites)

tbl_Target_Coords - Target coordinates for sample locations

Index	*Index columns*
Location_ID	Location_ID
pk_tbl_Target_Coords (primary)	Location_ID, Target_type
Target_type	Target_type
Target_updated	Target_updated

Field name	*Index/key*	*Data type*	*Description*
Location_ID	primary (FK)*	text (50)	Sample location
Target_type	primary *	text (10)	Type of target (e.g., start or end point)
Target_UTME		double	Target UTM easting (zone 10N)
Target_UTMN		double	Target UTM northing (zone 10N)
Target_datum		text (5)	Target coordinate datum
	Default: "NAD83"		
Target_notes		memo	Notes about the target coordinates
Target_created_date		datetime	Time stamp for record creation
	Default: Now()		
Target_updated	indexed	datetime	Date of the last update to this record
Target_updated_by		text (50)	Person who made the most recent edits

tbl_Task_List - Checklist of tasks to be completed at sampling locations

Index	*Index columns*
Date_completed	Date_completed
pk_tbl_Task_List (primary)	Location_ID, Request_date, Task_desc
Task_status	Task_status

Field name	*Index/key*	*Data type*	*Description*
Location_ID	primary (FK)*	text (50)	Sampling location
Request_date	primary *	datetime	Date of the task request
	Default: Now()		
Task_desc	primary *	text (100)	Brief description of the task
Requested_by		text (50)	Name of the person making the initial request
Task_status	indexed *	text (50)	Status of the task
	Default: "Active"		
Date_completed	indexed	datetime	Date the task was completed
Followup_by		text (50)	Name of the person following up on or completing the task
Task_notes		memo	Notes about the task
Followup_notes		memo	Comments regarding what was done to follow-up on or complete this task

tbl_Transect_Obs - Transect segment observation data

Index	*Index columns*
Event_ID	Event_ID
Nativeness	Nativeness
pk_tbl_Transect_Obs (primary)	Observation_ID
Segment_num	Segment_num
Substrate	Substrate
Veg_type	Veg_type
Cover_class	Cover_class

Field name	*Index/key*	*Data type*	*Description*
Observation_ID	primary *	int	Unique identifier for each observation record (also the sort order for data entry)
Event_ID	indexed (FK)*	text (50)	Sampling event
Segment_num	indexed	smallint	Sequential number assigned in the field for linking GPS records with data sheet records
Segment_length_m		single	Calculated length of the veg type segment
No_GPS	*	bit	Flag to indicate that no GPS position was recorded for the current record
	Default: False		
UTME		double	Final UTM easting (zone 10N, meters) derived from corrected GPS coordinates or, if none, from field values
UTMN		double	Final UTM northing (zone 10N, meters) derived from corrected GPS coordinates or, if none, from field values
Field_UTMN		int	Field northing value denoting the southernmost boundary of the transect segment
Veg_type	indexed	text (10)	Vegetation type of the transect segment
Nativeness	indexed	text (10)	Native or exotic species predominate
Cover_class	indexed	text (10)	Vegetative cover for the transect segment (recorded for exotic species where nativeness = N, and for native species cover where nativeness = E)
Is_grazed		bit	Flag to indicate that the transect segment was grazed
	Default: False		
Substrate	indexed	text (10)	Substrate of the transect segment
Obs_notes		text (100)	Comments about this observation made during the field event

Flag	*	tinyint	Internal flag used to identify records with potential sequence errors (either 0=no problem, 1=flagged and unresolved, or 2=reviewed)
	Default: 0		
Office_notes		text (150)	Record processing notes

tlu_Coord_Source - List of coordinate data sources (standard)

Field name	*Index/key*	*Data type*	*Description*
Coord_source	primary *	text (12)	
Coord_source_desc		text (100)	
Sort_order		tinyint	

tlu_Coord_Type - List of coordinate types (standard)

Field name	*Index/key*	*Data type*	*Description*
Coord_type	primary *	text (20)	
Coord_type_desc		text (100)	
Sort_order		tinyint	

tlu_Cover_Class - List of cover classes

Field name	*Index/key*	*Data type*	*Description*
Cover_class	primary *	text (10)	
Class_desc		text (100)	
Sort_order		tinyint	

tlu_Datum - List of coordinate datum codes (standard)

Field name	*Index/key*	*Data type*	*Description*
Datumprimary *	text (5)		
Datum_desc		text (50)	
Sort_order		tinyint	

tlu_Edit_Type - List of the types of post-certification edits made to data (standard)

Field name	*Index/key*	*Data type*	*Description*
Edit_type	primary *	text (12)	
Edit_type_desc		text (100)	
Sort_order		tinyint	

tlu_GPS_Model - List of GPS devices used to collect coordinate data (template)

Field name	*Index/key*	*Data type*	*Description*
GPS_model	primary *	text (25)	
Sort_order		tinyint	

tlu_Image_Format - List of image, map, and photographic formats (template)

Field name	*Index/key*	*Data type*	*Description*
Image_format	primary *	text (12)	
Image_format_desc		text (100)	
Sort_order		tinyint	

tlu_Image_Quality - List of quality ranks for images (template)

Field name	*Index/key*	*Data type*	*Description*
Quality_code	primary *	tinyint	
Image_quality	*	text (20)	
Image_quality_desc		text (100)	

tlu_Image_Type - List of image types (template)

Field name	*Index/key*	*Data type*	*Description*
Image_type	primary *	text (12)	
Image_type_desc		text (100)	
Sort_order		tinyint	

tlu_Location_Type - List of location type codes (template)

Field name	*Index/key*	*Data type*	*Description*
Location_type	primary *	text (20)	
Loc_type_desc		text (200)	
Sort_order		tinyint	

tlu_Nativeness_Code - List of nativeness codes

Field name	*Index/key*	*Data type*	*Description*
Nativeness	primary *	text (10)	
Nativeness_desc		text (100)	
Sort_order		tinyint	

tlu_Observer_Role - List of observer role assignments (template)

Field name	*Index/key*	*Data type*	*Description*
Observer_role	primary *	text (25)	
Role_desc		text (100)	
Sort_order		tinyint	

tlu_Origin_Code - List of origin codes for park taxa (standard)

Field name	*Index/key*	*Data type*	*Description*
Origin_code	primary *	text (16)	
Origin_desc		text (100)	
NPSpp_ID		smallint	
Sort_order		tinyint	

tlu_Panel_Type - List of sampling panel types (template)

Field name	*Index/key*	*Data type*	*Description*
Panel_type	primary *	text (20)	
Panel_type_desc		text (200)	
Sort_order		tinyint	

tlu_Parks - List of NCCN parks and park codes (standard)

Field name	*Index/key*	*Data type*	*Description*
Park_code	primary *	text (4)	
Park_name		text (50)	

tlu_Park_Taxa - Park-specific attributes for taxa (template)

Index	*Index columns*
Park_origin	Park_origin
Park_status	Park_status
pk_tlu_Park_Taxa (primary)	Taxon_ID, Park_code
Record_status	Record_status

Field name	*Index/key*	*Data type*	*Description*
Taxon_ID	primary (FK)*	text (50)	Taxon identifier
Park_code	primary *	text (4)	Park code
Park_status	indexed *Default*: "Unknown"	text (16)	Status of the taxon in this park (from NPSpecies)
Park_origin	indexed *Default*: "Unspecified"	text (16)	Origin of the taxon in this park (from NPSpecies)

Local_list		bit	Indicates that the taxon is the preferred one for use at the park (from NPSpecies)
Local_accepted_TSN		int	Taxonomic serial number of the local preferred taxon (from NPSpecies)
Preferred_sci_name		text (255)	Preferred scientific name of the taxon at the park (from NPSpecies)
Park_taxon_notes		memo	Comments about the taxon specific to this park
Record_status	indexed	text (16)	Indicates the status of the record in terms of synchrony with master databases
	Default: "New record"		
Created_date		datetime	Time stamp for record creation
	Default: Now()		
Updated_date		datetime	Date of the last update to this record
Updated_by		text (50)	Person who made the most recent edits

tlu_Park_Taxon_Status - List of codes for park species occurrence (standard)

Field name	*Index/key*	*Data type*	*Description*
Taxon_status_code	primary *	text (16)	
Taxon_status_desc		text (250)	
NPSpp_ID		smallint	
Sort_order		tinyint	

tlu_Project_Crew - List of personnel associated with a project (template)

Index	*Index columns*
Contact_location	Contact_location
Contact_updated	Contact_updated
First_name	First_name
Last_name	Last_name
Organization	Organization
pk_tlu_Project_Crew (primary)	Contact_ID
Project_code	Project_code

Field name	*Index/key*	*Data type*	*Description*
Contact_ID	primary *	text (50)	Unique identifier for the individual (Lastname_Firstname_MI)
Contact_is_active		bit	Indicates that the contact record is currently available for data entry pick lists
	Default: True		
Project_code	indexed *	text (10)	Project code, for linking information with other data sets and applications
Last_name	indexed *	text (24)	Last name
First_name	indexed	text (20)	First name
Middle_init		text (4)	Middle initials
Organization	indexed	text (50)	Employer (e.g., NPS-MORA)
Position_title		text (50)	Position title held by the individual
Email		text (50)	Email address
Work_voice		text (25)	Work phone number
Work_ext		text (5)	Work extension number
Mobile_voice		text (25)	Mobile phone number
Home_voice		text (25)	Home phone number
Fax		text (25)	Fax number
Contact_location	indexed	text (255)	Where the individual is located
Contact_notes		memo	Notes about the contact
Contact_created		datetime	Time stamp for record creation
	Default: Now()		
Contact_updated	indexed	datetime	Date of the last update to this record

Contact_updated_by	text (50)	Person who made the most recent edits

tlu_Project_Taxa - List of species associated with project observations (template)
Constraints: : ([Taxon_is_active] And [Refers_to] Is Null) Or ([Taxon_is_active]=False And [Refers_to] Is Not Null)

Index	*Index columns*
Accepted_TSN	Accepted_TSN
Category	Category
pk_tlu_Project_Taxa (primary)	Taxon_ID
Project_code	Project_code
Record_status	Record_status
Scientific_name (unique)	Scientific_name
Species_code (unique)	Species_code
Subcategory	Subcategory
Taxon_type	Taxon_type
TSN	TSN

Field name	*Index/key*	*Data type*	*Description*
Taxon_notes		memo	General notes about the taxon
Created_date		datetime	Time stamp for record creation
	Default: Now()		
Updated_date		datetime	Date of the last update to this record
Updated_by		text (50)	Person who made the most recent edits
Taxon_is_active		bit	Indicates that the record is currently available for data entry pick lists
	Default: True		
Record_status	indexed	text (16)	Indicates the status of the record in terms of synchrony with master databases
	Default: "New record"		
Refers_to		text (50)	Valid taxon the record should refer to for analysis and summaries
Rec_status_notes		text (255)	Notes about the disposition of the record
Project_taxon_notes		memo	Project-specific comments about the taxon
Taxon_ID	primary *	text (50)	Unique identifier for each taxon
	Default: =Format(Now(),"yyyymmddhhnnss") & '-' & 1000000000*Rnd(Now())		
Project_code	indexed *	text (10)	Project code, for linking information with other data sets and applications
Species_code	unique *	text (20)	Unique field code for each project taxon
Scientific_name	unique *	text (100)	Scientific name of the taxon (from ITIS/NPSpecies)
Common_name		text (100)	Common name for the taxon (from ITIS/NPSpecies)
Pref_com_name		text (100)	Preferred common name for this project
TSN	indexed	int	ITIS taxonomic serial number or a provisional number (from NPSpecies)
Accepted_TSN	indexed	int	ITIS taxonomic serial number of the accepted name for this taxon (from NPSpecies)
Category	indexed *	text (20)	General category of the taxon (from NPSpecies)
	Default: "Unspecified"		
Subcategory	indexed	text (20)	Subcategory specific to the needs of each taxonomic discipline (from NPSpecies)
Authority		text (60)	Taxonomic authority (from ITIS)
Authority_subsp		text (60)	Taxonomic authority for subspecific taxa (from ITIS)
Family		text (60)	Taxonomic family (from ITIS)
Taxon_type	indexed *	text (12)	Indicates the taxonomic resolution and certainty represented by this record
	Default: "Specific"		

tlu_Site_Status - List of status codes for sampling stations (standard)

Field name	*Index/key*	*Data type*	*Description*
Site_status	primary *	text (10)	
Site_status_desc		text (200)	
Sort_order		tinyint	

tlu_Substrate - List of cover classes

Field name	*Index/key*	*Data type*	*Description*
Substrate_code	primary *	text (10)	
Substrate_desc		text (100)	
Sort_order		tinyint	

tlu_Taxon_Category - List of taxonomic categories (standard)

Field name	*Index/key*	*Data type*	*Description*
Category	primary *	text (20)	
Category_desc		text (100)	
NPSpp_ID		smallint	
Sort_order		tinyint	

tlu_Taxon_Rec_Status - List of status codes for taxon records (standard)

Field name	*Index/key*	*Data type*	*Description*
Record_status_code	primary *	text (16)	
Record_status_desc		text (200)	
Sort_order		tinyint	

tlu_Taxon_Type - List of taxon resolution codes (standard)

Field name	*Index/key*	*Data type*	*Description*
Taxon_type	primary *	text (12)	
Taxon_type_desc		text (200)	
Sort_order		tinyint	

tlu_Veg_Type - List of vegetation types

Field name	*Index/key*	*Data type*	*Description*
Veg_type	primary *	text (10)	
Veg_desc		text (100)	
Sort_order		tinyint	

tsys_App_Releases - Application table - Application release history

Index	*Index columns*
pk_tsys_App_Releases (primary)	Release_ID
udx_tsys_App_Releases (unique)	Release_date, Database_title, Version_number

Field name	*Index/key*	*Data type*	*Description*
Release_ID	primary *	text (50)	Unique identifier for the release
	Default: =Format(Now(),"yyyymmddhhnnss") & '-' & 1000000000*Rnd(Now())		
Release_date	unique *	datetime	Date of the release
Database_title	unique *	text (100)	Title of the database
Version_number	unique *	text (20)	Version control number
File_name		text (50)	Filename, used to identify older versions of the database
Release_by		text (50)	Person who issued the release
Release_notes		memo	Release notes, which may include a summary of revisions
Is_supported	*	tinyint	Indicates the support level of this release: 0=user must use a newer version; 1=supported but newer available; 2=full support, current version
	Default: 2		

tsys_Bug_Reports - Application table - Application bugs and development history

Index	*Index columns*
Fix_date	Fix_date
pk_tsys_Bug_Reports (primary)	Bug_ID
Release_ID	Release_ID
Report_date	Report_date

Field name	*Index/key*	*Data type*	*Description*
Bug_ID	primary *	text (50)	Unique identifier for each bug record
	Default: =Format(Now(),"yyyymmddhhnnss") & '-' & 1000000000*Rnd(Now())		
Release_ID	indexed (FK)*	text (50)	Database release version of the report
Report_date	indexed *	datetime	Date the bug was reported
	Default: =Date()		
Found_by		text (50)	Person who found the bug
Reported_by		text (50)	Person who filled out this bug report
Report_details		memo	Nature of the bug report
Fix_date	indexed	datetime	Date the bug was fixed
Fixed_by		text (50)	Person who fixed the bug
Fix_details		memo	Notes on fix

tsys_Logins - Application table - Log of user access to the database through the front-end

Field name	*Index/key*	*Data type*	*Description*
Time_stamp	primary *	datetime	Time stamp of activity record
	Default: Now()		
User_name	primary *	text (50)	Login name of the user
Action_taken		text (50)	Action taken by the user

tsys_User_Roles - Application table - Determines user access privileges through the front-end

Field name	*Index/key*	*Data type*	*Description*
User_name	primary *	text (50)	Network login
User_role	*	text (50)	Database application role, used to determine the access level

Appendix E. Template for Prairie Vegetation Monitoring Annual Report

The annual report should consist of the following information and sections:

Authors/Contacts

Introduction/Background

Boilerplate for each report covering the following:

- Importance of prairie vegetation monitoring in the NCCN and our ecoregion
- Monitoring Objectives and connection to Ecological Integrity Scorecard (see Tables E.1 and E.2)
- Study design – spatial and temporal aspects; target population for each combination of camp and vegetation stratum
- Overview of Accomplishments of current year (i.e., if transects and quadrats were monitored, which camp was monitored) (see Tables E.3 and E.4)
- Detection of change and trend, based on initiation of monitoring in 2011. Values reported for all transects, all vegetation strata, and for the entire set of plots (see Tables E.5 through E.10)

Table E.1. Hierarchy of monitoring questions and link to management issue.

Objective	Metric type	Response Variables	Ecological Integrity Rating[1]		
			Good	**Caution**	**Significant Concern**
1. Detect change in the extent of physiognomic cover types	Landscape Structure	Cover type: forest vs. non-forest[2]	<10% difference between annual estimate of either tree or non-tree cover from baseline	10-30% difference between annual estimate of either tree or non-tree cover from baseline	>30% difference between annual estimate of either tree or non-tree cover from baseline
2. Detect change in the proportion of area dominated by exotic plant species	Vegetation Community Structure	Total Park Cover	≤10% of area is dominated by exotic species	11-30% of area is exotic	>30% of area is exotic
		Tree (forest) Cover	≤10% of area is exotic	11-30% of area is exotic	>30% of area is exotic
		Shrub Cover	≤10% of area is exotic	11-30% of area is exotic	>30% of area is exotic
		Herbaceous Cover	≤10% of area is exotic	11-30% of area is exotic	>30% of area is exotic
3. Detect change in quality of native herbaceous communities	Quality of native herbaceous communities	Exotic Cover	90% of native-dominated areas have ≤10% exotic cover	≤50% of native-dominated areas have >50% exotic cover	>50% of native-dominated areas have >50% exotic cover
		Mean C[3]	≥10	4-10	1-3
		Average Weed Score[4]	1	1-2	2+

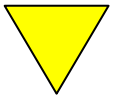
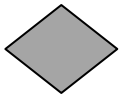
[1] Ecological integrity rating reflects the status of the parameter and trend will be used as a modifier to describe whether the condition of the parameter is stable, improving, or declining.

[2] The baseline for this objective is the ratio of forest to nonforest cover that was present during the historic period of significance 1853-1875. The metric for this parameter will be the ratio of soils that developed under forest vs. non- forest vegetation as interpreted by the soils survey (see Figures 4 and 5) as this reflects the cover types that were present during the historic time period.

[3] The mean C will be used in concert with native species richness, FQI, and native species cover. The estimates in the table are preliminary estimates based on pilot data, see Appendix B.

[4] Weed score is based on local ranking that is under development following Bowers and Boutin 2008, see Appendix B.

Table E.2. Ecological integrity categories used in this report.

Ecological Integrity (Status)		Trend	
Good: the condition of the indicator or measure is satisfactory		*Improving*: the condition of the indicator/measure is improving	
Caution: the condition of the indicator or measure is fair		*Stable*: the condition of the indicator/measure is not changing	
Significant Concern: the condition of the indicator or measure is poor or low		*Declining*: the condition of the indicator/measure is declining	
Not rated: there is insufficient data to determine the status		*Not rated*: there is insufficient information to determine trend	N/R

[1] Adapted from Parks Canada. 2008. Yoho, National Park of Canada, State of the park report.

Annual Accomplishments

Summary of Methods and Overview of Accomplishments

- Quick review of methods (i.e. transects and quadrats)
- Tables E.3 and E.4 illustrating where sampling occurred in current and past years
- Maps of American and English Camps illustrating transects that were mapped and plots that were sampled during the reporting year.

Table E.3. Temporal sampling frame for transects. Numbers indicate the number of transects in each panel, using American Camp as an example.

	Year																			
Panel Type	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Annual	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Rotating 1	5					5					5					5				
Rotating 2		5					5					5					5			
Rotating 3			5					5					5					5		
Rotating 4				5					5					5					5	
Rotating 5					5					5					5					5

Table E.4. History of quadrats visited (or missed) throughout study. Note that the number of quadrats at the two Camps and among years will be different (values are for illustration only).

Camp	Cover Type	2009	2010	2011	2012	2013	2014 etc.
American	Herbaceous (native)	81	X	X	X	X	X
	Herbaceous (exotic)	332	X	X	X	X	X
English	Herbaceous (native)	X	X	X	X	X	X
	Herbaceous (exotic)	X	X	X	X	X	X

Summary of Results

- Summary of cover data by transect, cover type, and origin of vegetation.
- Summary of vegetation plot data by species cover and by transect.
- Summary of vegetation plot data utilizing species richness, mean C, FQI, and weed scores.

Table E.5. Total length (m) of cover types by transect at American Camp (2009 pilot data are presented).

Panel -	Trees		Shrubs		Herbaceous				
Transect	Native	Exotic	Native	Exotic	Native	Exotic	Unvegetated	Developed	Total
1-1	560	0	0	0	0	0	0	0	560
1-2	528	0	86	11	88	676	0	15	1404
1-3	581	0	0	0	42	281	58	18	981
1-4	513	0	236	18	87	421	46	15	1335
1-5	356	0	20	26	163	459	64	15	1103
1-6	510	0	216	0	174	345	0	17	1262
1-7	214	0	2	3	196	893	53	28	1389
1-8	302	0	9	4	63	324	65	12	779
1-9	299	0	87	38	97	971	6	11	1509
1-10	0	0	33	16	524	624	53	9	1258
1-11	529	0	0	0	37	205	39	10	820
1-12	454	52	269	8	202	295	32	14	1327
1-13	449	0	215	5	108	788	56	16	1638
1-14	250	0	45	0	59	277	232	9	872
1-15	519	0	80	40	162	625	3	19	1448
1-16	0	0	106	3	240	867	54	0	1270
1-17	610	0	0	33	4	225	5	13	890
1-18	446	0	260*	5	190	328	0	8	1238
1-19	250	0	37	0	228	819	60	23	1417
1-20	399	0	0	6	30	408	8	9	859
4-1	291	0	382	38	189	503	0	11	1414
4-2	348	0	0	0	181	499	85	15	1129
4-3	541	0	12	0	35	297	6	11	902
4-4	310	0	0	0	0	0	0	0	310
4-5	109	0	316	0	115	888	59	30	1516
Total	9368	52	2413	254	3214	12018	984	328	

*This includes 3.18m of shrub cover whose nativeness was not recorded but assumed to be native.

Table E.6. Mean (and SE) of percent cover for cover types at American Camp. D=Developed, H=Herbaceous, S=Shrub, T=Tree, U=Unvegetated (2009 pilot data are presented).

Vegetation Type	2009	2010	2011
D	1.10 (0.10)		
H	47.17 (4.34)		
S	7.44 (1.65)		
T	40.68 (5.01)		
U	3.60 (1.01)		

Table E.7. Mean (and SE) of percent cover for exotic and native vegetation types at American Camp. D=Developed, H=Herbaceous, S=Shrub, T=Tree, U=Unvegetated, E=Exotic, and N=Native (2009 pilot data are presented).

Vegetation Type	Nativeness	2009	2010	2011
H	E	37.43 (3.38)		
H	N	9.74 (1.63)		
S	E	0.86 (0.22)		
S	N	6.58 (1.62)		
T	E	0.15 (0.15)		
T	N	40.54 (5.01)		

Table E.8. Mean (and SE) of percent cover for forest and non-forest vegetation types at American Camp. Non-forest types include herbaceous, shrub, and unvegetated cover types. F=Forest and NF=Non-forest (2009 pilot data are presented).

Vegetation Type	2009 Estimate	2010	2011
F	40.68 (5.01)		
NF	58.22 (4.98)		

Table E.9. Mean (and SE) of percent cover for exotic (E) and native (N) herbaceous vegetation types at American Camp: total and by cover class (2009 pilot data are presented).

Nativeness	Native cover	Exotic cover	2009	Total
E	0-10%		67.42 (2.93)	80.37 (2.25)
E	11-50%		12.95 (1.70)	
N	51-100%	0-10%	7.98 (1.40)	
N	51-100%	11-50%	9.04 (1.63)	19.63 (2.25)
N	51-100%	51-100%	2.61 (0.74)	

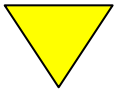
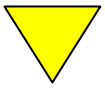
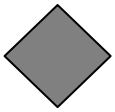
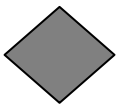
Table E.10. Mean (and SE) of percent exotic (E) and native (N) tree and shrub cover at American Camp (2009 pilot data are presented).

Nativeness	Shrub	Trees
E	27.51 (7.69)	0.41 (0.41)
N	72.49 (7.69)	99.59 (0.41)

Summary/Conclusions

- Description of differences among plots and differences over time (when available) of species composition of prairie plots.
- Comparison across vegetation types and across parks within vegetation type.
- Discussion of vegetation cover and use of FQI, Weed scores, species richness, and species cover estimates (no pilot data is available to present here) to inform assessment of prairie status.
- Review of Table E.1 (Hierarchy of monitoring questions and link to management issues) with respect to data collected to date; evaluation of response variables and ecological integrity rating categories.
- Update of Ecological Integrity Scorecard (Table E.11).

Table E.11. Ecological Integrity Scorecard based on data collected at American Camp in 2009.

Metric	Rating	Interpretation
Landscape Structure		Good Condition: The proportions of tree:prairie cover types today is compatible with the character of the cultural landscape during the period of significance.
Abundance of Exotic Plant Species		
All Cover Types		Significant Concern: Approximately 38% of all vegetation is exotic in origin
Trees		Good Condition: <1% of all tree cover is exotic in origin.
Shrubs		Caution: Approximately 28% of all shrub cover is exotic in origin.
Herbaceous		Significant Concern: Approximately 80% of all herbaceous vegetation is exotic in origin.
Quality of Native Herbaceous Cover		
Exotic Cover		Caution: 87% of all native herbaceous prairies have <50% cover of exotic species.
Floristic Quality Index		Not rated: there is insufficient data to determine the status
Average Weed Score		Not rated: there is insufficient data to determine the status

Appendix F. Job Hazard Analysis

JOB HAZARD ANALYSIS (JHA)		Date: **January 6, 2011**	☒ New JHA ☐ Revised JHA
Park Unit: **San Juan Island National Historical Park**	Division: **Resource Management**	Branch: **Resource Management**	Location: **Parkwide**
TASK TITLE: **Prairie vegetation monitoring**		JHA Number:	Page ___1___of __4____
Job Performed By: **SAJH Resource Management Staff**	Analysis By: Mignonne Bivin	Supervisor: Jack Oelfke	Approved By:

Required Standards and General Notes:	
Required Training:	Good physical condition; MVOs current Defensive Driving
Required Personal Protective Equipment:	Standard field apparel; long pants, long-sleeved shirts, boots with ankle support. Sun protection (sun screen, sun glasses, brimmed hat), rain gear, wind protection and warm clothing.
Tools and Equipment:	Plot frames, GPS units, meter tapes, notebooks, hand lens, flagging, handheld radios, spare batteries for radios, first aid kits.

Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Travel to the site	Vehicle condition Weather Road Conditions Other Drivers Animals Backing vehicle	• Perform pre-trip inspection on vehicle. Conduct scheduled PM inspections. • Drive to avoid accident situations created by weather or road conditions. • Always wear your seat belt. Reduce speed when driving on wet surfaces. • To prevent accidents, make concessions to other drivers who are thoughtless, unskilled, or ignorant of the hazards they create. Alway use a person to serve as a guide for backing when available. Use chock blocks when parked. • Always drive defensively. Be aware. Do not drive when distracted, tired or ill.

Figure F.1. Job Hazard Analysis form.

JHA - CONTINUATION SHEET	JHA Number:	Page __2___of __4___
Sequence of Job Steps	**Potential Hazards**	**Safe Action or Procedure**
Hiking to and around site	Traveling on uneven terrain, steep slope and forested slopes	• Wear sturdy boots with good soles. • Pay attention to footing, look for rabbit warrens and holes. • When walking on steep slopes, be sure foot placement is secure. • When walking on forested slopes, be cautious of foot placement. Be aware of branches at face level, even when you are focusing on the ground. • When walking in the prairies, be aware of vines or trailing plants that could cause a tripping hazard.
	Dehydration/Exhaustion	• Employees should be in good physical condition. Take breaks when hiking up steep slopes. Carry two quarts of water, and drink throughout the day.
	Hypothermia	• Layer your clothing such that it will be easy to regulate your body temperature by adding or subtracting layers. DO NOT wear cotton as a layer. Instead, wear clothing that stays warm when wet, such as polypropylene or other synthetics. • Expect rain, and carry appropriate gear.
	Lightning	• Check the forecast prior to fieldwork and watch the sky. If lightning is predicted, reschedule fieldwork. If in the field and lightning is approaching, seek shelter in sturdy buildings or in an automobile with windows closed. • Avoid single trees, tall structures, and metal objects. If in a forested area, do not touch or lean on trees. Spread out from crew members (lightening can travel between people). • As a last resort, assume a crouch on the ground with your weight on the balls of the feet, your feet together, head lowered, and ears covered.

Figure F.1. Job Hazard Analysis form (continued).

JHA - CONTINUATION SHEET	JHA Number:	Page __3___of __4___
Sequence of Job Steps	Potential Hazards	Safe Action or Procedure
Data entry and office tasks	Repetitive motion injuries, eye strain	• Stretch often, change positions, and take breaks. • Ensure the work space is ergonomically correct. • Ensure the office space has proper lighting.

Figure F.1. Job Hazard Analysis form (continued).

JHA - CONTINUATION SHEET	JHA Number:	Page __4__ of __4__
Text Description of Task When it is Done Safely		

Authorized Employee Information			
Employee ID	Last Name	First Name	Qualifications/Remarks

Figure F.1. Job Hazard Analysis form (continued).

INSTRUCTIONS FOR COMPLETING THE JOB HAZARD ANALYSIS FORM

Job Hazard Analysis (JHA) is an important accident prevention tool that works by finding hazards and eliminating or minimizing them *before* the job is performed, and *before* they have a chance to become accidents. Use your JSA for job clarification and hazard awareness, as a guide in new employee training, for periodic contacts and for retraining of senior employees, as a refresher on jobs which run infrequently, as an accident investigation tool, and for informing employees of specific job hazards and protective measures. Set priorities for doing JHA's: jobs that have a history of many incidents, jobs that have produced disabling injuries, jobs with high potential for disabling injury or death, and new jobs with no accident history. Here's how to do each of the three main parts of a Job Hazard Analysis:

SEQUENCE OF JOB STEPS

Break the job down into steps. Each of the steps of a job should accomplish some major task. The task will consist of a *set* of movements. Look at the first *set* of movements used to perform a task, and then determine the next logical *set* of movements. For example, the job might be to move a box from a conveyor in the receiving area to a shelf in the storage area. How does that break down into job steps? Picking up the box from the conveyor and putting it on a hand truck is one logical set of movements, so it is one job step. Everything is related to that one logical set of movements is part of that job step.

The next logical *set* of movements might be pushing the loaded hand truck to the storeroom. Removing the boxes from the truck and placing them on the shelf is another logical set of movements. And finally, returning the hand truck to the receiving area might be the final step in this type of job.

Be sure to list *all* the steps in a job. Some steps might not be done each time checking the casters on a hand truck, for example. However, that task is a part of the job as a whole, and should be listed and analyzed.

POTENTIAL HAZARDS

Identify the hazards associated with each step. Examine each step to find and identify hazards – actions, conditions, and possibilities that could lead to and accident.

It's not enough to look at the obvious hazards. It's also important to look at the entire environment and discover every conceivable hazard that might exist.

Be sure to list health hazards as well, even though the harmful effect may not be immediate. A good example is the harmful effect of inhaling a solvent or chemical dust over a long period of time.

It's important to list *all* hazards. Hazards contribute to accidents, injuries, and occupational illnesses.

In order to do part three of a JHA effectively, you must identify potential and existing *hazards*. That's why it's important to distinguish between a hazard, and accident and an injury. Each of these terms has a specific meaning:
HAZARDS – Potential danger. Oil on the floor is a hazard.
ACCIDENT – An unintended happening that may result in injury, loss or damage. Slipping on the oil is an accident.
INJURY – The result of an accident. A sprained wrist from the fall would be an injury.

Some people find it easier to identify possible accidents and illnesses and work back from them to the hazards. If you do that, you can list the accident and illness types in parentheses following the hazard. But be sure you focus on the *hazard* for developing recommended actions and safe work procedures.

SAFE ACTION OR PROCEDURE

Using the first two columns as a guide to decide what actions are necessary to eliminate or minimize the hazards that could lead to an accident, injury, or occupational illness.

Among the actions that can be taken are, 1) engineering the hazard out; 2) providing personal protective equipment; 3) job instruction training; 4) good housekeeping; and 5) good ergonomics (positioning the person in relation to the machine or other elements in the environment in such a way as to eliminate stresses and strains).

List recommended safe operating procedures on the form, and also list required or recommended personal protective equipment for each step of the job.

Be specific. Say *exactly* what needs to be done to correct the hazard, such as, "lift using your leg muscles." Avoid general statements like, "be careful."

Give a recommended action or procedure for *every* hazard.

If the hazard is a serious one, it should be corrected immediately. The JSA should then be changed to reflect the new conditions.

Figure F.1. Job Hazard Analysis form (continued).

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 963/115055, June 2012

National Park Service
U.S. Department of the Interior

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